

**Programme Name/s** : Automobile Engineering./ Mechanical Engineering/ Mechatronics/ Production Engineering/  
**Programme Code** : AE/ ME/ MK/ PG  
**Semester** : Third / Fourth  
**Course Title** : THEORY OF MACHINES  
**Course Code** : 313313

**I. RATIONALE**

Diploma Engineer should be able to identify and interpret various elements of machines in day-to-day life when they come across various machines in practice. In maintaining various machines, a Diploma Engineer should have sound knowledge of fundamentals of machine and mechanism. TOM subject imparts the kinematics involved in different machine elements and mechanisms like I.C. engine, cam-follower, belt-pulley, gear, flywheel etc. This course serves as a prerequisite for other courses such as Machine Design of higher semester etc.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

This course will enable the students to: Apply the knowledge & skills related to machine, mechanism & motions according to field applications.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Apply knowledge and skill related to different mechanisms and its motion in given situation.
- CO2 - Determine velocity and acceleration for given mechanism.
- CO3 - Develop a Cam profile for given type of Follower and its motions in given situation.
- CO4 - Select the suitable power transmission devices for the given field/industrial application.
- CO5 - Use knowledge and skills related to balancing of masses and vibration for various applications.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

| Course Code | Course Title       | Abbr | Course Category/s | Learning Scheme          |     |     |       |       |        | Credits | Paper Duration | Assessment Scheme |       |             |       |    |   |   |   | Total Marks |     |
|-------------|--------------------|------|-------------------|--------------------------|-----|-----|-------|-------|--------|---------|----------------|-------------------|-------|-------------|-------|----|---|---|---|-------------|-----|
|             |                    |      |                   | Actual Contact Hrs./Week |     |     | SLH   | NLH   | Theory |         |                | Based on LL & TL  |       | Based on SL | Total |    |   |   |   |             |     |
|             |                    |      |                   | CL                       | TL  | LL  |       |       |        |         |                | Practical         |       |             |       |    |   |   |   |             |     |
|             |                    |      |                   |                          |     |     | FA-TH | SA-TH | Total  |         |                | FA-PR             | SA-PR | SLA         |       |    |   |   |   |             |     |
| Max         | Max                | Max  | Min               | Max                      | Min | Max | Min   | Max   | Min    |         |                |                   |       |             |       |    |   |   |   |             |     |
| 313313      | THEORY OF MACHINES | TOM  | DSC               | 4                        | -   | 2   | -     | 6     | 3      | 3       | 30             | 70                | 100   | 40          | 25    | 10 | - | - | - | -           | 125 |

**Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

#### V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's.  | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.  | Suggested Learning Pedagogies.   |
|-------|---|--|--|
| 1     | <p>TLO 1.1 Identify various links and pairs in the given mechanism.</p> <p>TLO 1.2 Identify various type motion in the given pair.</p> <p>TLO 1.3 Identify various kinematic chain in the given configuration.</p> <p>TLO 1.4 Estimate degree of freedom for given configuration.</p> <p>TLO 1.5 Explain different inversion of mechanism.</p> <p>TLO 1.6 Select suitable inversion of mechanism for different application.</p> | <p><b>Unit - I Fundamentals and Types of Mechanism</b></p> <p>1.1 Kinematics of Machines: - Definition of statics, Dynamics, Kinematics, Kinetics, Kinematic link and its types, Kinematic pair and its types, constrained motion and its types</p> <p>1.2 Kinematic chain (locked chain, constrained chain and unconstrained chain with equation), Degree of freedom (Kutzbach equation)</p> <p>1.3 Mechanism and Inversion: Mechanism and Inversion of Mechanism, Difference between machine and structure.</p> <p>1.4 Inversion of Kinematic Chain a) Inversion of four bar chain: Beam engine, Coupling rod of Locomotive, Watt's indicator mechanism. b) Inversion of single slider Crank chain: Reciprocating I.C. engine, Whitworth quick return mechanism, Rotary Engine, Oscillating cylinder engine, Crank and slotted lever quick return Mechanism, Hand Pump mechanism c) Inversion of Double Slider Crank Chain: Elliptical trammel, Scotch Yoke Mechanism, Oldham's Coupling</p> | <p>Classroom<br/>Lecture<br/>Model<br/>Demonstration<br/>Video<br/>Demonstrations<br/>Hands-on<br/>Presentations</p> |

| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's.  | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.  | Suggested Learning Pedagogies.  |
|-------|--|--|---|
| 2     | <p>TLO 2.1 Describe velocity and acceleration in mechanism.</p> <p>TLO 2.2 Draw velocity and acceleration diagram/polygon by relative velocity/ Klein's construction method following standard procedure .</p> <p>TLO 2.3 Determine linear and angular velocity of links in the given mechanism.</p> <p>TLO 2.4 Determine linear and angular acceleration of links in the given mechanism.</p>   | <p><b>Unit - II Velocity and Acceleration in Mechanism</b></p> <p>2.1 Concept of relative velocity and acceleration of a point on a link, Inter-relation between linear and angular velocity and acceleration.</p> <p>2.2 Drawing of velocity and acceleration diagram of a given configuration, diagrams of simple Mechanisms: four bar chain and single slider crank chain (Limited up to 4 Links).</p> <p>2.3 Determination of velocity and acceleration of point on link by relative velocity method (Excluding Coriolis component of acceleration) .</p> <p>2.4 Klein's construction to identify velocity and acceleration of different links in single slider crank mechanism (When crank rotates with uniform velocity only).</p>   | <p>Lecture Using Chalk-Board<br/>Video<br/>Demonstrations</p>   |
| 3     | <p>TLO 3.1 Explain Cam and its terminology with field application.</p> <p>TLO 3.2 Identify the type of motion of Follower.</p> <p>TLO 3.3 Classify Cams and Followers.</p> <p>TLO 3.4 Draw Cam profile as per the given condition of Follower.</p>   | <p><b>Unit - III Cam and Follower</b></p> <p>3.1 Introduction to Cams and Followers, definition and applications of Cams and Followers, Cam terminology.</p> <p>3.2 Classification of Cams and Followers.</p> <p>3.3 Different follower motions and their displacement diagrams - Uniform velocity, simple harmonic motion, uniform acceleration and retardation.</p> <p>3.4 Drawing of profile of radial Cam with knife-edge and roller Follower with and without offset (reciprocating motion only).</p>   | <p>Lecture Using Chalk-Board<br/>Model<br/>Demonstration<br/>Video<br/>Demonstrations<br/>Presentations</p> |
| 4     | <p>TLO 4.1 Identify the different drives for power transmission.</p> <p>TLO 4.2 Select suitable drive for a particular application.</p> <p>TLO 4.3 Calculate various quantities like velocity ratio, belt tensions, angle of contact, power transmitted in belt drives.</p> <p>TLO 4.4 Enlist advantages and disadvantages of chain drive.</p> <p>TLO 4.5 Identify the different types of gear trains.</p> <p>TLO 4.6 Compare belt drive, chain drive and gear drive for given parameters.</p> | <p><b>Unit - IV Power transmission (Belt, Chain and Gear)</b></p> <p>4.1 Belt Drive: a) Type of belts, flat belt, V-belt &amp; its applications, material for flat and V-belt, Selection of belts<br/>b) Angle of lap, length of belt (No derivation), Slip and creep, Determination of velocity ratio of tight side and slack side tension, Power transmitted by belt. (numerical on power transmission by belt)</p> <p>4.2 Chain Drives: Types of chains and sprockets, Advantages &amp; Disadvantages of chain drive over other drives (No numerical on Chain drive).</p> <p>4.3 Gear Drives: a) Classification of gears, Law of gearing, Concept of Conjugate profile (Involute only) Spur gear terminology. b) Types of gear trains, Train value &amp; velocity ratio for simple, compound, reverted and epicyclic gear trains. (No numerical on Gear drive).<br/>Comparison between Belt drive, Chain drive and Gear drive</p> | <p>Lecture Using Chalk-Board<br/>Presentations<br/>Video<br/>Demonstrations<br/>Model<br/>Demonstration</p> |

| Sr.No | Theory Learning Outcomes (TLO's) aligned to CO's.   | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.   | Suggested Learning Pedagogies.   |
|-------|---|---|--|
| 5     | <p>TLO 5.1 Explain the concept of balancing.</p> <p>TLO 5.2 Find balancing mass and position of plane analytically and graphically in single plane.</p> <p>TLO 5.3 Explain the basic vibrating system with causes and remedies.</p> | <p><b>Unit - V Balancing of Masses and Vibration</b></p> <p>5.1 Balancing of Rotating Masses: Concept of balancing: Need and types of balancing, Balancing of single rotating mass.</p> <p>5.2 Analytical and Graphical methods for balancing of several masses revolving in same plane and different plane (Numerical on single plane only).</p> <p>5.3 Vibration: Fundamentals of Vibration: Definition and concept of Free, Forced, Undamped, Damped vibrations. (no numerical)</p> <p>5.4 Advantages and Disadvantages of Vibration, Causes and remedies of Vibration, Vibration isolators. Forced vibrations of longitudinal and torsional systems (Concepts only, No numerical and No derivation on vibration).</p> | <p>Lecture Using Chalk-Board Presentations Video Demonstrations Case Study</p> |

#### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Practical / Tutorial / Laboratory Learning Outcome (LLO)   | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles  | Number of hrs. | Relevant COs                     |
|--|-------|---|----------------|----------------------------------|
| <p>LLO 1.1 Identify different mechanisms available in laboratories/institute premises</p> <p>LLO 1.2 Sketch the identified mechanism.</p>                                  | 1     | <p>Identification of Mechanisms in the different laboratory and institute premises.</p>   | 2              | <p>CO1</p> <p>CO3</p> <p>CO4</p> |
| <p>LLO 2.1 Identify number of links and pairs of given mechanism</p> <p>LLO 2.2 Identify input link and its motion.</p> <p>LLO 2.3 Identify output link and its motion</p> | 2     | <p>*Estimation of kinematic data for mechanism available in the laboratory (any one from Group A and any one from Group B)</p> <p>Group A:</p> <p>i) Beam Engine</p> <p>ii) Coupling rod of Locomotive,</p> <p>iii) Watt's indicator mechanism.</p> <p>Group B:</p> <p>i) Reciprocating engine</p> <p>ii) Whitworth quick return mechanism.</p> <p>iii) Rotary Engine</p> <p>iv) Crank and slotted lever quick return Mechanism</p> <p>v) Hand Pump mechanism</p> | 2              | <p>CO1</p>                       |

| Practical / Tutorial / Laboratory Learning Outcome (LLO)   | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles  | Number of hrs. | Relevant COs |
|--|-------|---|----------------|--------------|
| LLO 3.1 Identify number of links and pairs of given mechanism.<br>LLO 3.2 Identify input link and its motion.<br>LLO 3.3 Identify Output link and its motion.      | 3     | Estimation of kinematic data for mechanism available in the laboratory (any one from Group A and any one from Group B)<br><br>Group A:<br>i) Elliptical trammel,<br>ii) Scotch Yoke Mechanism,<br>iii) Oldham's Coupling<br><br>Group B:<br>i) Bicycle free wheel sprocket mechanism<br>ii) Geneva mechanism<br>iii) Ackerman's steering gear mechanism<br>iv) Foot operated air pump mechanism | 2              | CO1          |
| LLO 4.1 Determine degree of freedom of given mechanism   | 4     | *Degree of Freedom of given mechanism by using Kutzbach equation.<br><br>(Any five mechanisms available in the Laboratory)  | 2              | CO1          |
| LLO 5.1 Measure the ratio of time of cutting stroke to the return stroke in shaping operation.   | 5     | *Quick return mechanism used in a shaper machine  | 2              | CO1          |
| LLO 6.1 Draw velocity and acceleration polygon of four bar chain.<br>LLO 6.2 Calculate angular velocity and linear velocity of a link using given data.            | 6     | Velocity and Acceleration of four bar chain by relative velocity method.<br><br>(Two Problem on A2 size Sheet.)   | 2              | CO2          |
| LLO 7.1 Draw velocity and acceleration polygon of single slider crank chain.<br>LLO 7.2 Calculate angular velocity and linear velocity of a link using given data. | 7     | *Velocity and Acceleration of single slider crank chain by relative velocity method.<br><br>(Two Problem on A2 size Sheet.)   | 2              | CO2          |
| LLO 8.1 Draw a space diagram of a single slider crank mechanism<br>LLO 8.2 Measure the velocity and acceleration of links using Klien's construction method.       | 8     | Velocity and Acceleration of Slider crank chain by Klien's Construction Method.   | 2              | CO2          |

| Practical / Tutorial / Laboratory Learning Outcome (LLO)  | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles   | Number of hrs. | Relevant COs |
|---|-------|--|----------------|--------------|
| LLO 9.1 Generate cam profile for given follower to obtain desired follower motion                                 | 9     | Cam profile for knife edge Follower. (Two problem on A2 size sheet, at least one problem on offset follower) | 2              | CO3          |
| LLO 10.1 Generate cam profile for given follower to obtain desired follower motion                                | 10    | Cam Profile for roller follower. (Two Problem on A2 size sheet, at least one problem on offset follower)     | 2              | CO3          |
| LLO 11.1 Identify displacement of follower with cam rotation  | 11    | *Measurement of follower displacement with Cam rotation for knife edge follower and roller follower          | 2              | CO3          |
| LLO 12.1 Measure the angular speed using tachometer.<br>LLO 12.2 Compute the length of belt and slip              | 12    | *Estimation of slip, length of belt, angle of contact in an open and cross belt drive.                       | 2              | CO4          |
| LLO 13.1 Identify the type of gears and gear train.   | 13    | Identification of gears and gear train in Lab and Machine shop.  | 2              | CO4          |
| LLO 14.1 Identify the type of gears and gear train.<br>LLO 14.2 Construct gear train for desirable velocity ratio | 14    | *Preparation of different Gear trains from the given gears.  | 2              | CO4          |
| LLO 15.1 Construct balanced system for rotating masses.   | 15    | *Balancing of rotating unbalanced system   | 2              | CO5          |

**Note : Out of above suggestive LLOs -**

- '\*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

NA

- NA

**Note :**

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

| Sr.No | Equipment Name with Broad Specifications   | Relevant LLO Number |
|-------|--|---------------------|
| 1     | Working Model of Beam Engine, Coupling rod of Locomotive, Watt's indicator mechanism, Reciprocating engine, Whitworth quick return mechanism, Rotary Engine, Crank and slotted lever quick return Mechanism, Hand Pump mechanism   | 1,2,4               |
| 2     | Shaper machine available in institute workshop   | 1,2,4,5             |
| 3     | Working Models of Elliptical trammel, Scotch Yoke Mechanism, Oldham's Coupling, Bicycle free wheel sprocket Mechanism, Geneva mechanism, Ackerman's steering gear Mechanism, Foot operated air pump mechanism  | 1,3,4               |
| 4     | Working models of Flat belt and V belt arrangement for demonstration   | 1,4,12              |
| 5     | Experimental cam follower set up: Machine consist of a cam shaft driven by a D.C. motor/Manual operated. The shaft runs in a double ball bearing. At the free end of the cam shaft a cam can be easily mounted. The follower is properly guided in bushes and the type of the follower can be changed to suit the cam under test. A graduated circular protractor is fitted coaxial with the shaft and a dial gauge can be fitted to note the follower displacement for the angle of cam rotation. A spring is used to provide controlling force to the follower system. | 11                  |
| 6     | Tachometer: optical type of tachometer (digital Tachometer) Range speed minimum 0 to 2000RPM or more   | 12                  |
| 7     | Belt drive test bench A test bench comprising of following pulleys, belts, electrical motor, arrangement for adjusting belt tensions and regulating speed of the driving motor and a suitable mounting frame   | 12                  |
| 8     | Working Model of Gear Trains: i) Simple Gear Train ii) Compound Gear train iii) Reverted Gear Train iv) epicyclic Gear Train   | 13                  |
| 9     | Different types of Gears with different modules : at least 5 quantity of each gear Spur gear Helical gear (Single /double) Spiral gear Bevel gear  | 13                  |
| 10    | Experimental set up to arrange gears and shaft such that desired gear train can be obtained for given velocity ratio.  | 14                  |
| 11    | Static & Dynamic Balancing Machine Single phase motor connected to a shaft, containing 4 rotating masses. Each rotating mass has a facility to insert. Pulley is provided to add weights to balance the unbalance shaft  | 15                  |
| 12    | Working models of various Cam follower arrangements for demonstration (Radial cam with knife edge and Roller follower models are mandatory)  | 4,9,10,11           |

#### IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

| Sr.No              | Unit | Unit Title                                | Aligned COs | Learning Hours | R-Level   | U-Level   | A-Level   | Total Marks |
|--------------------|------|---|-------------|----------------|-----------|-----------|-----------|-------------|
| 1                  | I    | Fundamentals and Types of Mechanism       | CO1         | 16             | 6         | 8         | 4         | 18          |
| 2                  | II   | Velocity and Acceleration in Mechanism    | CO2         | 10             | 2         | 4         | 6         | 12          |
| 3                  | III  | Cam and Follower                          | CO3         | 10             | 4         | 4         | 6         | 14          |
| 4                  | IV   | Power transmission (Belt, Chain and Gear) | CO4         | 16             | 4         | 8         | 4         | 16          |
| 5                  | V    | Balancing of Masses and Vibration         | CO5         | 8              | 4         | 4         | 2         | 10          |
| <b>Grand Total</b> |      |   |             | <b>60</b>      | <b>20</b> | <b>28</b> | <b>22</b> | <b>70</b>   |

#### X. ASSESSMENT METHODOLOGIES/TOOLS

**Formative assessment (Assessment for Learning)**

- Laboratory Performance and Term work, Class Test I & II
- Term work (Lab Manual and drawing sheet), Question and Answers in class room as well as at the time of Practical. Note: Each practical will be assessed considering 60% and 40 % weightage.

**Summative Assessment (Assessment of Learning)**

- End Semester Board exam- Theory

**XI. SUGGESTED COS - POS MATRIX FORM**

| Course Outcomes (COs) | Programme Outcomes (POs)                     |                       |                                       |                        |  |                         |                         | Programme Specific Outcomes* (PSOs) |       |       |
|-----------------------|--|-----------------------|---------------------------------------|------------------------|--|-------------------------|-------------------------|-------------------------------------|-------|-------|
|                       | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1                               | PSO-2 | PSO-3 |
| CO1                   | 3  | -                     | -                                     | 2                      | -  | -                       | 2                       |                                     |       |       |
| CO2                   | 3  | 2                     | 1                                     | -                      | -  | -                       | -                       |                                     |       |       |
| CO3                   | 3  | 2                     | 3                                     | 2                      | -  | -                       | 1                       |                                     |       |       |
| CO4                   | 3  | 2                     | 1                                     | 2                      | 1  | -                       | 2                       |                                     |       |       |
| CO5                   | 3  | 2                     | 1                                     | 2                      | 2  | -                       | 1                       |                                     |       |       |

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

| Sr.No | Author                      | Title                             | Publisher with ISBN Number  |
|-------|-----------------------------|-----------------------------------|---|
| 1     | A. Ghosh, A. K. Malik       | Theory Of Mechanisms and Machines | Affiliated East west press ISBN: 978-8185938936                   |
| 2     | S. S. Rattan                | Theory Of Machines                | Tata McGraw Hill Edu. New Delhi, 2010, ISBN: 978-9353166281       |
| 3     | R.S. Khurmi, J. K. Gupta    | Theory of Machines                | S. Chand and Company New Delhi, ISBN: 978-8121925242              |
| 4     | J. E. Shigely, J. J. Uicker | Theory Of Machines and Mechanisms | Tata McGraw Hill Edu. New Delhi, 2010, ISBN: 978-0198062325       |
| 5     | R. K. Bansal, Brar J. S.    | A text book of Theory of Machine  | Khanna Book Publishing CO(P) LTD, New Delhi, ISBN: 9788170084181  |
| 6     | P. L. Ballaney              | Theory Of Machines                | Khanna Book Publishing CO(P) LTD, New Delhi, ISBN: 978-8174091222 |
| 7     | Sadhu Singh                 | Theory of Machines                | Pearson Education ISBN: 978-8131760697                            |
| 8     | S.S. Rao                    | Mechanical Vibrations             | Pearson Education 2018 ISBN: 978-9353062569                       |
| 9     | G.K. Grover                 | Mechanical Vibration              | 978-8185240565  |

**XIII . LEARNING WEBSITES & PORTALS**

| Sr.No   | Link / Portal   | Description   |
|---|---|---|
| 1   | <a href="http://www.mechanalyzer.com/downloads.html">http://www.mechanalyzer.com/downloads.html</a>   | Mech Analyzer is a free software developed to simulate and analyze the mechanisms |
| 2   | <a href="https://www.youtube.com/watch?v=oTcC_xXfdrA">https://www.youtube.com/watch?v=oTcC_xXfdrA</a>   | Coupling Rod Locomotive   |
| 3   | <a href="https://www.youtube.com/watch?v=8shK6kbu7Xk">https://www.youtube.com/watch?v=8shK6kbu7Xk</a>   | Piston cylinder animation showing application of cam and gear train               |
| 4   | <a href="https://www.youtube.com/watch?v=yHHeicPbEzg">https://www.youtube.com/watch?v=yHHeicPbEzg</a>   | Simple Beam Engine  |
| 5   | <a href="https://www.youtube.com/watch?v=yHHeicPbEzg">https://www.youtube.com/watch?v=yHHeicPbEzg</a>   | Knife edge follower and Radial Cam  |
| 6   | <a href="https://www.youtube.com/watch?v=Rib-_ZK8KfE">https://www.youtube.com/watch?v=Rib-_ZK8KfE</a>   | Roller follower with Radial Cam   |
| 7   | <a href="https://www.youtube.com/watch?v=AODiJYtxuSw">https://www.youtube.com/watch?v=AODiJYtxuSw</a>   | Gear train animation  |
| 8   | <a href="https://www.youtube.com/watch?v=klVYeSlxucU">https://www.youtube.com/watch?v=klVYeSlxucU</a>   | Types of Belt drives  |
| 9   | <a href="https://www.udemy.com/course/theory-of-machines-determine-degrees-of-freedom-in-a-system/">https://www.udemy.com/course/theory-of-machines-determine-degrees-of-freedom-in-a-system/</a>   | Degree of freedom   |
| 10  | <a href="https://archive.nptel.ac.in/courses/112/106/112106270/">https://archive.nptel.ac.in/courses/112/106/112106270/</a>   | Online NPTEL lectures of Theory of machine  |
| 11  | <a href="https://play.google.com/store/apps/details?id=com.pinjara_imran5290.Belt_Length_Calculator&amp;hl=en&amp;gl=US&amp;pli=1">https://play.google.com/store/apps/details?id=com.pinjara_imran5290.Belt_Length_Calculator&amp;hl=en&amp;gl=US&amp;pli=1</a> | Belt length calculator Application (play store app)                               |
| 12  | <a href="https://psmotion.com/mechdesigner/feature/cam-design-analysis">https://psmotion.com/mechdesigner/feature/cam-design-analysis</a>   | Design of Cam software  |
| 13  | <a href="https://www.vlab.co.in/broad-area-mechanical-engineering">https://www.vlab.co.in/broad-area-mechanical-engineering</a>   | Virtual Lab   |
| 14  | <a href="https://opac.library.iitb.ac.in/">https://opac.library.iitb.ac.in/</a>   | Digital Central Library   |
| <p><b>Note :</b></p> <ul style="list-style-type: none"> <li>Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students</li> </ul> |   |   |