

Ramgarhia Polytechnic College, Phagwara



Mechanical Engineering Department

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| Head of Department: | Er. Gaurav Kumar |
| Name of the Faculty: | Er. Gaurav Kumar |
| Discipline: | Mechanical Engineering Department |
| Semester: | 5 th |
| Subject: | Metrology and Instrumentation |
| Lesson Plan Duration: | 16 Weeks |







RATIONALE

Metrology is the science of measurement, Diploma holders in this course are responsible for ensuring process and quality control by making measurements and carrying out inspection of various parameters. For this purpose, knowledge and skills about various measuring instruments are required. The aim of this subject is to develop knowledge and skills regarding various measuring instruments amongst the students.

COURSE OUTCOME

After undergoing the subject, students will be able to :

- CO1. Use vernier caliper, micrometer, and Height gauge for linear internal and external measurement.
- CO2. Use bore gauge, radius gauge, taper gauge, plug gauge, ring gauge, snap gauge for measurements.
- CO3. Use bevel protector, sine bar, slip gauge, dial indicator, angle deckor, poppy dial for angular measurements.
- CO4. Measure spur gear characteristics using gear tooth vernier, outside diameter over dovel pins.
- CO5. Use tool makers microscope Measure surface roughness parameters. Use profile projector, auto collimeter, angle deckor.
- CO6. Select and measure variables using electrical and electronics comparators and measuring instrument, sensors, transducers.
- CO7. Select and use non destructive testing methods.
- CO8. Explain the use of coordinate measuring machine.

| PO \Rightarrow | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
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| CO1 |  | | |  | | | |
| CO2 |  | | |  | | | |
| CO3 |  | | |  | | | |
| CO4 |  | | |  | | | |
| CO5 |  | | |  | | | |
| CO6 |  | | |  | | | |
| CO7 |  | | |  | | | |
| CO8 |  | | |  | | | |

Syllabus

| Units | Details | Hours |
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| 1. | <p>Introduction Definition of metrology Standard of measurement Types of Errors - Controllable and random errors Precision, accuracy, sensitivity, hysteresis, response time, repeatability, calibration, uncertainty of measurement, interchangeability. Standardization and standardizing organizations</p> | (06 hrs) |
| 2. | <p>Linear and Angular Measurement Construction features and use of instruments for non precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block. Construction features and use of instruments for precision measurements : vernier calipers, vernier height and depth gauges, micrometers. Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges. Cylinder bore gauges, feeler and wire gauges. Checking flatness, roundness and squareness Comparators – Characteristics, uses, working principles of different types of comparators: mechanical, electrical, electronics and pneumatic . 2.6. Construction and use of instruments for angular measurements: bevel protector, sine bar, angle gauges, clinometer, angle dekker. Optical instruments for angular measurement, auto collimator.</p> | (18 hrs) |
| 3. | <p>Measurement of Surface Finish Terminology of surface roughness. Concept of primary texture and secondary texture. Factors affecting surface finish. CLA, RMS and RA value. Principle and operation of stylus probe instruments. Tomlinson surface meter and Taylor surface talysurf.</p> | (06 hrs) |
| 4. | <p>Measurements of Screw threads and Gauges Measurement of screw threads- Introduction, measurements of external and core diameters, checking of pitch and angle of threads with gauges. Measurements of gears (spur) – Measurement of tooth thickness, pitch, Gear Ball tester, Lead and Profile Testers. Profile projector, Coordinate Measuring Machine (CMM), Tool maker's microscope.</p> | (08 hrs) |
| 5. | Instrumentation | (08 hrs) |

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| | <p>Various types of instruments used for mechanical quantities such as displacement, velocity, acceleration, speed and torque. Use of transducers and electronic counters, stroboscope, vibrating reeds and tachometers.</p> <p>Strain gauge – use of strain gauge and load cells Note: There should be a visit to established metrology lab to familiarize students with purpose and need of metrology</p> | |
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LIST OF PRACTICALS

1. Internal and external measurements with vernier calliper and microscope
2. Measurement of linear dimensions with height gauge and depth gauge.
3. Measurement of flatness, concentricity with dial indicator
4. Use of feeler gauge, wire gauge, radius gauge and fillet gauges for checking of standard parameters.
5. Use of plain plug and ring gauge, taper plug and ring gauge, thread plug and ring gauge and snap gauges.
6. Measurement of Angle using;
 - i) Cylindrical rollers and spherical balls and slip gauges
 - ii) Bevel protector
 - iii) Sine Bar/Sine Table , Slip Gauges, Height Gauge and dial indicator.
 - iv) Angle deckor.
7. Measurement of spur gear characteristics;
 - i) Measurement over teeth (M.O.T) by using flange/Disc micrometer.
 - ii) P.C.D run-out using bench centre, mandrel, cylindrical pin and dial indicator.
 - iii) Composite error using Gear Roller Tester and Master Gear.
8. Measurement of thread parameters by using tool maker's microscope.
9. Measurement of effective diameter of external threads by 2-wire and 3-wire method.
10. Measurement of cylindrical bore using cylinder bore gauge for bore diameter, ovality and taper.
11. Measurement of worn out IC engine piston clearance between cylinder and piston.
12. Measurement of surface roughness using surface roughness tester.
13. Measurement of co-ordinates of two or more than two holes using surface plate, angle plate, Height Gauge, dial indicator and slip gauges.
14. Measurement of a profile using profile projector.

15. Study and use of Auto-Collimator.

INSTRUCTIONAL STRATEGY

1. Demonstrate use of various measuring instruments while imparting theoretical instructions.
2. Stress should be laid on correct use of various instruments.

Reference Books:

1. Engineering Metrology by RK Jain; Khanna Publishers, New Delhi.
2. A Text Book of Production Engineering by RC Sharma; S Chand and Company, New Delhi.
3. Metrology Laboratory Manual by M Adithan and R Bahl; NITTTR, Chandigarh.
4. Engineering Metrology by RK Rajput; SK Kataria and Sons, Ludhiana.

Delivery/Instructional Methodologies

| Sr.No. | Description |
|--------|-------------------------|
| 1. | Chalk and Talk |
| 2. | PowerPoint Presentation |

Assessment Methodologies

| Sr. No. | Description | Type |
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| 1. | Student Assignment | Direct |
| 2. | Test | Direct |
| 3. | Board Examination | Direct |
| 4. | Student Feedback | Direct |

Gaps in the syllabus - to meet industry/profession requirements

| S.NO. | DESCRIPTION | PROPOSED ACTIONS | PO MAPPING |
|-------|-------------|------------------|------------|
| | N/A | N/A | N/A |

Topics beyond syllabus/advanced topics

| Units | Details | Hours |
|-------|---------|-------|
| N/A | N/A | N/A |

Web Source References

| Sr. No. | URL |
|---------|---|
| 1. | https://nptel.ac.in/ |

Lesson Plan

| Week | Theory | | Practical | |
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| | Lecture Day | | Practical Day | 2 hours a week |
| | 1 st | Definition of metrology | | Internal and external measurements with vernier calliper and microscope |
| | 2 nd | Standard of measurement | | |

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| 1 st | | | 1. | |
| | 3 rd | Types of Errors - Controllable and random errors | | |
| | 4 th | Precision, accuracy, sensitivity, hysteresis, response time, repeatability, calibration, uncertainty of measurement, interchangeability. | 2. | Measurement of linear dimensions with height gauge and depth gauge |
| 2 nd | 5 th | Standardization and standardizing organizations | | |
| | 6 th | Construction features and use of instruments for non precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block. | | |
| | 7 th | | | |
| 8 th | | | | |
| 3 rd | 9 th | Construction features and use of instruments for precision measurements: vernier calipers, vernier height and depth gauges, micrometers. | 3. | Measurement of flatness, concentricity with dial indicator |
| | 10 th | | | |
| | 11 th | Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges. | | |
| | 12 th | | | |
| 4 th | 13 th | Cylinder bore gauges, feeler and wire gauges. Checking flatness, roundness and squareness | 4. | Use of feeler gauge, wire gauge, radius gauge and fillet gauges for checking of standard parameters |
| | 14 th | | | |
| | 15 th | Comparators – Characteristics, uses, working principles of different types of | | |
| | 16 th | | | |

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| | | comparators: mechanical, electrical, electronics and pneumatic. | | |
| 5 th | 17 th | Construction and use of instruments for angular measurements: bevel protector, sine bar, angle gauges, and clinometer, angle dekker. Optical instruments for angular measurement, auto collimator. | 5. | Use of plain plug and ring gauge, taper plug and ring gauge, thread plug and ring gauge and snap gauges. |
| | 18 th | | | |
| | 19 th | Terminology of surface roughness. | | |
| | 20 th | Concept of primary texture and secondary texture. | | |
| 6 th | 21 st | Factors affecting surface finish. | 6. | Measurement of Angle using; i) Cylindrical rollers and spherical balls and slip gauges ii) Bevel protector iii) Sine Bar/Sine Table , Slip Gauges, Height Gauge and dial indicator. iv) Angle deckor. |
| | 22 nd | CLA, RMS and RA value. | | |
| | 23 rd | | | |
| | 24 th | 1st Sessional Test (Tentative) | | |
| 7 th | 25 th | Principle and operation of stylus probe instruments. Tomlinson surface meter and Taylor surface talysurf. | 7. | Measurement of spur gear characteristics; i) Measurement over teeth (M.O.T) by using flange/Disc micrometer. ii) P.C.D run-out using bench centre, mandrel, cylindrical pin and dial indicator. iii) Composite error using Gear Roller Tester and Master Gear. |
| | 26 th | | | |
| | 27 th | | | |
| | 28 th | Measurement of screw threads- Introduction, measurements of external and core | | |
| 29 th | Measurement of thread parameters by using | | | |

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| 8 th | 30 th | diameters, | 8. | tool maker's microscope. |
| | 31 st | | | |
| | 32 nd | | | |
| 9 th | 33 rd | Checking of pitch and angle of threads with gauges. | 9. | Measurement of effective diameter of external threads by 2-wire and 3-wire method. |
| | 34 th | | | |
| | 35 th | | | |
| | 36 th | | | |
| 10 th | 37 th | Measurements of gears (spur) Measurement of tooth thickness, pitch, Gear Ball tester, Lead and Profile Testers | 10. | Measurement of cylindrical bore using cylinder bore gauge for bore diameter, ovality and taper. |
| | 38 th | | | |
| | 39 th | | | |
| | 40 th | | | |
| 11 th | 41 st | Profile projector | 11. | Measurement of worn out IC engine piston clearance between cylinder and piston. |
| | 42 nd | | | |
| | 43 rd | | | |
| | 44 th | | | |
| 12 th | 45 th | 2nd Sessional Test (Tentative) | 12. | Measurement of surface roughness using surface roughness tester. |
| | 46 th | | | |
| | 47 th | | | |

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| | 48 th | | | |
| 13 th | 49 th | Tool maker's microscope. | 13. | Measurement of co-ordinates of two or more than two holes using surface plate, angle plate, Height Gauge, dial indicator and slip gauges. |
| | 50 th | | | |
| | 51 st | | | |
| | 52 nd | Various types of instruments used for mechanical quantities such as displacement, velocity, acceleration, speed and torque. | | |
| 14 th | 53 rd | | 14 | Measurement of a profile using profile projector. |
| | 54 th | | | |
| | 55 th | | | |
| | 56 th | | | |
| 15 th | 57 th | Use of transducers and electronic counters, stroboscope, vibrating reeds and tachometers. | 15. | Study and use of Auto-Collimator. |
| | 58 th | | | |
| | 59 th | | | |
| | 60 th | Strain gauge – use of strain gauge and load cells | | |
| 16 th | 61 st | | 16. | Viva-voice |
| | 62 nd | | | |
| | 63 rd | | | |
| | 64 th | 3rd Sessional Test (Tentative) | | |