



B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2023

(Regulation 2018)

Fifth Semester

AUTOMOBILE ENGINEERING

U18AUT5102: Design of Machine Elements

COURSE OUTCOMES

CO1: Familiarize and apply the design morphology in designing various machine element

CO2: Selecting suitable material for the machine elements

CO3: Calculate and analyze the force acting on the machine elements

CO4: Choosing the appropriate machine element for the required function

CO5: Designing a machine element from the given data

Time: Three Hours

Maximum Marks: 100

Answer all the Questions: -

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

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| 1. How is the factor of safety defined for brittle and ductile material? | CO1 | [K ₁] |
| 2. Define endurance limit. What are the factors affecting endurance strength? | CO1 | [K ₁] |
| 3. List the types of stresses acting on a shaft. | CO2 | [K ₁] |
| 4. A line shaft rotating at 200 rpm is to transmit 20 kw .It may be assumed to be made of mild steel with an allowable shear stress of 42 MPa. Determine the diameter of the shaft, neglecting the bending moment on the shaft | CO2 | [K ₄] |
| 5. Name some advantages of gear drives | CO3 | [K ₁] |
| 6. How gears are classified? | CO3 | [K ₁] |
| 7. Name some mode of failure of rolling contact bearing | CO4 | [K ₁] |
| 8. Explain the term bearing life | CO4 | [K ₂] |
| 9. Define coefficient of fluctuation of speed in the case of flywheels | CO5 | [K ₁] |
| 10. Name the stresses induced in flywheel arms | CO5 | [K ₁] |

Answer any FIVE Questions: -

PART B (5 x 16 = 80 Marks)

(Answer not more than 400 words)

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| 11. A hot rolled shaft of 40mm diameter is subjected to a torsional moment that varies from 330 Nm to -100 Nm and an applied bending moment which rises from 440 Nm to -220Nm.The material of the shaft has an ultimate strength of 550MN/m ² and yield strength of 410MN/m ² .Determine the approximate factor of safety using soderberg equation allowing endurance limit to be half the ultimate strength and size factor and surface finish factor to be 0.85 and 0.62 respectively. | 16 | CO1 | [K ₅] |
|--|----|-----|-------------------|

12. Compare the weight, strength and stiffness of a hollow shaft of the same internal diameter as that of a solid shaft. The inside diameter of the hollow shaft is being 0.6 times the external diameter. Both shafts have the same material and length. 16 CO2 [K₅]
13. A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low-speed shaft with a speed reduction of 3:1. The teeth are 141/2⁰ involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 MPa may be taken for the shaft on which the gear is mounted and for the key.
Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque. 16 CO3 [K₆]
14. A 50 mm diameter journal bearing rotates at 1500 rpm, L/D=1, radial clearance is 0.05 mm minimum film thickness = 0.01mm. Calculate the maximum radial load that the journal bearing can carry and still operate under hydrodynamic conditions. for this load, Determine the power lost in friction and increase in the oil temperature. Assume H_g = H_d, Absolute Viscosity = 20x10³ Pas ,Sp.Gravity of oil = 0.8, Sp.Heat of oil = 2.1 kJ/Kg⁰C 16 CO4 [K₅]
15. A safety valve of 60 mm diameter is to blow off at pressure of 1.2 N/mm². It is placed on its seat by a close-coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compressing spring of spring index 5 and provide an initial compression of 35mm. The maximum shear stress in the material of the wire is limited to 500N/mm². The modulus of rigidity for the spring material is 0.80x 10⁵ ?N/mm².Determine the i)Diameter of spring wire, ii)mean coil diameter, iii) number of active turns, iv)pitch of the coil 16 CO2 [K₅]
16. A single-cylinder double-acting steam engine delivers 185 kw at 100 rpm. The maximum fluctuation of energy per revolution is 15% of energy developed per revolution. The speed variation is limited to 1% either way from the mean. The mean diameter of the rim is 2.4m. Design a cast iron flywheel for the engine 16 CO5 [K₆]
