

SUBJECT: MECHANICAL ENGINEERING: PAPER-II (Set A)

Time: 3 hours

Full Marks: 200

Note: Answer Question N0. 1 and any four from the rest. All questions carry equal marks.

Q.No.1. Attempt any 10 (ten)

10×4=40

- a. What type of motion can be transmitted with a cam and follower combination? How are the cams classified?
- b. What is a worm and worm wheel? Where is it used?
- c. Explain in brief the terms sensitiveness and stability relating to governor.
- d. What do you mean by primary and secondary unbalance in reciprocating engine?
- e. Why radial load carrying capacity of roller bearing is more than ball bearing? Why roller bearing generates more noise than ball bearing?
- f. What is the difference between coupling and clutch? What are the differences between rigid and flexible coupling?
- g. Why is alloying needed in materials? What do you mean by 18-4-1 composition of high speed steel?
- h. What is the difference between recrystallization and reformation? Name any two heat treatment process for enhancement of surface properties.
- i. Draw a neat diagram to show the different cutting angles of a single point cutting tool for machining.
- j. What is the role of flexible fixture in a process? What do you mean by grades of grinding wheel?
- k. Briefly differentiate qualitative forecasting and quantitative forecasting.
- l. Where do we use maximum shear stress theory of failure? What do you mean by yield point and elastic limit?

Q.No.2. Attempt any 8 (eight)

8×5=40

- a. Define kinematic link, kinematic pair and kinematic chain in brief.
- b. What do you mean by centripetal and tangential component of acceleration and when do they occur?
- c. Define vibration isolation and transmissibility for a vibrating system.
- d. Discuss the advantages of V-belt over flat belt.
- e. Stress concentration has significant effect on design of machine element- explain in brief.
- f. What is the significance heat treatment in improvement of steel property?
- g. Briefly explain construction and working principle of wire EDM process.
- h. What are the differences between truss and frame from application point of view?
- i. Write two advantages and disadvantages of mechanical vibration in real life application.
- j. What do you mean by brazing? Explain the role of brazing in production of carbide tipped cutting tool.

Q.No.3. Attempt any 5 (five)

5×8=40

- Derive the equation of motion for a mass-spring-damper system representing a single degree of freedom system which is subjected to a harmonic excitation force.
- Derive the self-locking and overhauling condition for a screw jack in terms of helix angle and inclination angle.
- What do you mean by logarithmic decrement? Discuss about its role in vibrational analysis in brief.
- Draw a neat diagram for different phases in iron showing the salient points clearly and explain in brief.
- What is main difference between part program and Automatically Programmed Tool (APT)? Elaborate with a simple program?
- What is the role of flywheel in a machine? Derive coefficient of fluctuation in terms of speed of the flywheel
- What are the different casting defects?

Q.No.4. Attempt any 4 (four)

4×10=40

- Determine the deflection of the free end of a cantilever beam of length L which supports a UDL load w over the full span and a concentrated load F at the free end assuming Modulus of elasticity E and area moment of inertia I .
- A rectangular plate 1m long, 0.4 m wide and 20 mm thick is subjected to biaxial stresses along length and width respectively. If the increase in length and width is 0.6 mm and 0.09 mm respectively, determine value of biaxial stresses, change in thickness and change in volume of the plate.
- A solid cast iron disc 1m in diameter and 0.2 mm thick is used as a flywheel rotating at 350 rpm. It is brought to rest in 1.5 s by means of a brake. Calculate energy absorbed by the brake. Assume density of cast iron as 7200 kg/m³ and radius of gyration of solid disk about axis of rotation is .353 times of diameter.
- Each arm of a Porter governor is 200 mm long and is pivoted on the axis of the governor. The radii of rotation of the balls at the minimum and maximum speeds are 120 mm and 160 mm respectively. The mass of the sleeve is 20 kg and each ball is 4 kg. Find the range of speed of the governor. Also determine the range of speed if friction at the sleeve is 18 N.
- A vibratory system is required to design with parameters, spring stiffness of 100 N/m, damping coefficient of 2 N-s/m and mass 1 kg. Determine decrease in amplitude from its starting value after 3 complete oscillations.

Q.No.5. Attempt any 2 (two)

2×20=40

- Why balancing is necessary for rotors of high speed engines? What do you mean by swaying couple and hammer blow? Three masses of 8 kg, 12 kg and 15 kg attached at

radial distances of 80 mm, 100 mm and 60 mm respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses 12 kg and 15 kg relative to 8 kg mass. (5+5+10=20)

- b. What is the difference between simple gear train and compound gear train? Explain with the help of sketch. What is a reverted gear train and where is it used? A reverted gear train is used to provide a speed ratio 10. The module of the gear 1 and 2 is 3.2 mm and of gear 3 and 4 is 2 mm. Determine suitable numbers of teeth for each gear. No gear is to have less than 20 teeth and the center distance between shafts is 160 mm. (6+4+10=20)
- c. Distinguish between wet and dry grinding processes. Briefly describe advantages of centerless grinding. What is the function of bond in grinding wheel? Describe grit, grade and structure of a grinding wheel. (5+5+5+5=20)

Q.No.6. Attempt any 4 (four)

4×10=40

- a. What do you mean by mechanical drives? Give a short description about them.
- b. How would you classify non-traditional machining processes? Explain the specific features of these processes.
- c. Draw and discuss the different points on engineering stress strain curve for ductile material.
- d. Write in brief about Simplex method and its limitation in application.
- e. What do you mean by crystal imperfection? Discuss in brief about point defect, line defect and planer defects.

Q.No.7. Attempt any 2 (two)

2×20=40

- a. It is required to design a rigid type of flange coupling to connect two shafts i.e. the output shaft of an electric motor to the shaft of a centrifugal pump. The motor delivers 40 kW of power at 1440 rpm. If the starting torque of the motor can be assumed to be 1.5 times of the rated torque. Design the coupling and specify the dimensions of its components.
- b. It is required to design a helical compression spring subjected to maximum force of 1050 N. Deflection of the spring corresponding to maximum force should be 25 mm. Design the spring through proper design procedure. Assume suitable value of spring index, material for the spring, permissible stresses for that material and standard gap between consecutive coils, based upon the design requirements.
- c. For a torsional pendulum, the disc has a moment of inertia 500 kg-cm² which is immersed in a viscous fluid. The shaft attached to the disc is 45 cm long and has diameter of 12 cm. When the pendulum is vibrating, it is observed, amplitudes on the same side of the rest position for successive cycles are 9°, 6° and 4°. Determine, logarithmic decrement for the system, damping torque at unit velocity and the periodic time of vibration. Assume for the shaft, $G=4.4 \times 10^{10} \text{ N/m}^2$