

M. MTRL./9868/119/2006

M. TECH (MAT. ENGG) EXAMINATION, 2006

(2nd Semester)

DESIGN AND SELECTION OF MATERIALS

Time : Three hours

Full Marks : 100

Answer *question no. 8* and *five* from the rest

Assume any data if necessary for design

1. a) State and explain principal properties to be. Considered for the selection of a material for a given compen. 10
b) What are basic requirement of machine parts ? 6
2. a) Derive the expression for tangential stress in a thin walled cylinder carrying a gas or fluid under a pressure. 10
b) A compressed air cylinder for a laboratory use carries approximately 7 MPa pressure at the time of delivery. The inside diameter of such a cylinder is 250 mm. If the steel has a yield point of 230 MPa and if a safety factor of 2.5 is adequate, Calculate the required wall thickness. 6
3. a) Define a flywheel. State the classes of machines requiring flywheels, Explain with at least two examples of machines for each class. 8
b) A gas engine develops 50 kW at 1500 rpm speed. The maximum variation of energy per revolution is 27% of mean energy. The co-efficient of fluctuation of speed may be

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taken as 0.2. Determine the necessary mass of the flywheel rim if the rim provides the 95% of the flywheel effect. The mean velocity of the flywheel rim is limited to 40 metre/second. The density of cast iron may be taken as 7000 kg/metre cube. 8

4. a) State and explain determination of critical load for long column hinged at the ends. 10
- b) An eccentric rod to drive the valve mechanism of a steam engine carries a maximum compressive load of 20 kW, the length of the rod being 1.2 metre. Assume the eccentric rod to be hinged at both ends. Determine the diameter of the rod in the middle. Assume modulus of elasticity 0.21×10^6 MPa and factor of safety 30. 6
5. a) Derive the expression for spring deflection of a close coil helical spring elongated by an axial load 'P' and the spring composed of a wire or round rod of diameter 'd' wound into a helix of mean radius R. 8
- b) A close coiled helical spring having mean dia of coil 30 mm is subjected to a maximum load of 180 N and the deflection at this load is to be 25 mm. The torsional shear stress must not exceed 300 MPa. Suggest the suitable diameter of the spring wire. 8

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6. a) A steel shaft transmits 100 kW at 120 rpm. The maximum twisting moment during each revolution exceeds the mean by 30%. Suggest the suitable diameter for the solid shaft if the torsional shear stress is not to exceed 65 MPa. 8
- b) It is desired to bend a strip 6 mm thick and 20 mm wide of Spring steel into a loop with ends overlapping and riveted. Find the minimum radius of the loop if the stresses due to bending are limited to 100 MPa. Also determine the bending moment required to bend the strip. Take $E = 0.21 \times 10^6$ MPa. 8
7. a) State the law of gearing. 4
- b) Discuss various materials and their limitations on the selection of Gear wheels. 4
- c) In Belt drive what are the types of belts used ? 4
- d) It is required to drive a shaft at 620 rpm by means of a belt from a parallel shaft, having a pulley A = 30 cm diameter on it and running at 240 rpm. What sized pulley is required on the shaft B ? 4
8. a) State common causes of failure of a structural component. 5
- b) Write and explain application of various parameters to measure crack potency or crack extension force. 3

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- c) Determine the shape of the DCB (Double Cantilever Beam) specimen if G_I (Energy release rate in mode I) is to remain constant with the growth of the crack. The specimen is loaded in the constant load mode. Determine the depth 'h' of the specimen beyond the crack tip if thickness of specimen remains constant ($B = 30$ mm). The initial crack length is 50 mm, modulus is 207 GPa. 12