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B.Tech. 5th Semester End-Term Examination

M.E.

MACHINE DESIGN — I

(For New Regulation (w.e.f 2017 – 18) and

New Syllabus (w.e.f 2018 – 19)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

(Use of Design Data Handbook allowed)

Answer Question No. 1 and any *four* from the rest.

(Required data may be assumed from Design Data Handbook)

1. Choose the correct option : (10 × 1 = 10)
- (i) Which of the following theory of failure is mostly used for ductile materials?
- (a) Maximum principal stress theory
(b) Maximum shear stress theory
(c) Distortion energy theory
(d) Haigh's theory
- (ii) If 'd' is the diameter of a rivet, the margin is given by:
- (a) 1.2 d (b) 1.5 d
(c) 1.8 d (d) 2.0 d
- (iii) Which of the following shaft are the integrals or equally spaced lines made on a shaft?
- (a) Stepped shaft (b) Spline shaft
(c) Cam shaft (d) Crankshaft
- (iv) In a double cover single riveted butt joint, the rivet is subjected to
- (a) Single Shear (b) Double Shear
(c) Triple Shear (d) Quadruple Shear

[Turn over

- (v) Which of the following is not true for a good coupling?
- (a) It should be capable for transmitting power from one shaft to another
 - (b) It should keep shafts in proper alignment
 - (c) It should be easy to assemble and disassemble for repair and maintenance
 - (d) If there is small misalignment between the shafts, the coupling cannot transmit power
- (vi) A Shaft is mounted with a pulley which transmits power through a belt drive. The shaft is subjected to
- (a) Torsion only
 - (b) Bending only
 - (c) Combined Bending and Torsion
 - (d) None of these
- (vii) In a horizontal flat belt drive, which is normally true?
- (a) The top side is slack
 - (b) The top side is tight
 - (c) The top side may be either tight or slack
 - (d) None of these
- (viii) Which of the following materials are subjected to the most severe stress concentration?
- (a) Ductile materials under fluctuating load
 - (b) Brittle materials under static and fluctuating load
 - (c) Brittle materials under fluctuating load
 - (d) Ductile materials under static load
- (ix) Which of the following is not a type of welding joint?
- (a) Lap joint
 - (b) Butt joint
 - (c) Tee joint
 - (d) Single strap joint
- (x) Which is not a possible type of failure in a riveted joint?
- (a) Crushing failure of the plate
 - (b) Shear failure of rivet
 - (c) Tensile failure of the plate between rivets
 - (d) Shear failure of plate

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2. (a) Explain the concept of 'Maximum shear stress theory'.
 (b) A solid shaft made of steel is subjected to a moment of 5KN.m and a torque of 10 KN.m Determine the required shaft diameter according to (i) Maximum Normal Stress theory, (ii) Maximum shear stress theory
 (5 + 10 = 15)
3. Design a double riveted butt joint with two cover plates of 14 mm thick to join two plates of 18 mm thick. The pitch of the outer row of the rivet is to be doubled than the inner rows. The allowable stresses of the material considered are $\sigma_t = 120$, MPa, $\sigma_s = 80$ MPa and $\sigma_c = 170$ MPa. (15)
4. Design a flat belt drive to connect two horizontal shafts which are apart by 5 meters and to transmit 30 Kw from one shaft to another. The velocity ratio is 2.5 with driven pulley speed 1800 rpm. (15)
5. Design a Cast Iron flange coupling to transmit 20 kW at 1000 rpm from an electric motor to a compressor. The permissible stresses are as follows : (15)
 σ_c for bolt and key material = 85 N/sq.mm.
 σ_c for Cast Iron = 10 N/sq.mm.
 τ_s for shaft, bolt and key material = 45 N/Sq.mm
6. A Cotter Joint has to be designed to transmit a tensile load of 50 KN. The design stresses for the material of the joint are $\sigma_c = 410$ N/sq.mm., $\sigma_t = 350$ N/sq.mm and $\tau_s = 250$ N/Sq.mm. Check the design for all types of possible failures. (15)
7. A solid shaft is supported on two bearings 2.0 m apart and rotates at 420 rpm. A $14 \frac{1}{2}^\circ$ involute gear, 400 mm diameter is keyed to the shaft at a distance of 140 mm to the left of the right hand bearing. Two pulleys are located on the shaft at distances of 575 mm and 1250 mm respectively to the right of the left hand bearing. The diameters of the pulleys are 800 mm and 575 mm respectively. 45 kW is supplied to the gear, out of which 20 kW is taken off at the pulley 1 and 25 kW from the pulley 2. The drive from pulley 2 is vertically upward while from pulley 1 the drive is horizontal to the left. In both cases the tension ratio is 2 and angle of wrap is 180° . Design the shaft drive. (15)

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