

Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)

Sixth Semester B. Tech. (Mechanical Engineering)

Summer – 2018

Course Code: MEU602

Course Name: Machine Design - II

Time: 03 Hrs.

Max. Marks: 60

Instructions to Candidate

- 1) All questions are compulsory.
- 2) Use of Design Data Book is permitted. Assume suitable data if necessary and clearly state the assumptions made.
- 3) Diagrams/sketches should be given wherever necessary.
- 4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
- 5) Figures to the right indicate full marks.

1. (a) A mild steel carbon shaft transmitting 11.25kW at 210rpm is supported on two bearings 0.58m apart and has keyed to it two gears. An 18 tooth 20^0 involute 10mm module gear is located 0.125m to the right of the right hand bearing and delivers power to a gear directly below the shaft. An 80 tooth, 6mm module gear is located 0.15m to the right of left hand bearing and receives power from a gear directly over it. Calculate the diameter of shaft assuming shear stress as 70MPa and tensile stress as 84 MPa. 10

- (b) What are various types of key

02

Contd..

2. Solve any TWO

- (a) Design a rigid sleeve coupling to connect two shafts, transmitting 18.75kW at 1000rpm. The allowable shear stress in the material of the shaft is 55N/mm^2 . The material of the key and the shaft is same and coupling is required to transmit 20 percent overload. The material of sleeve is Cast Iron, the allowable shear stress for which is 16N/mm^2 06
- (b) A 250mm diameter pulley running at 920rpm drives another pulley of 700mm diameter pulley. The centre distance is 650mm. Flat leather belt is used to transmit the power of 7.5Kw. Both pulley are of cast Iron. Determine the cross section of belt and pulley. 06
- (c) Select a single row deep groove ball bearing for a radial load of 4000N and axial load of 5000N, operating at a speed of 1600rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load. 06

3. (a) What is hydrodynamic lubrication? 02

- (b) Design a journal bearing for centrifugal pump with the following data 1) Load on Journal- 2.5kN 2) Diameter of Journal- 50mm 3) Speed - 1440rpm 4) Ambient Temperature 25° , Operating oil temperature $= 70^\circ\text{C}$ 10

4. Solve Any ONE.

- (a) For reciprocating compressor power is to be supplied by 960 rpm motor to a compressor shaft running at 250 rpm through helical gear, power transmitted is 15kW. Design helical gear 12

- (b) A pinion running at 960 rpm transmits 12 kW to a gear running at 450 rpm. Selecting suitable material. Design a spur gear 12

- 5 (a) The chain drive is used in special purpose vehicle. The vehicle is runs by 30kW rotary engine. The efficiency of drive is 90%. The driving sprocket has 17 teeth and it rotates at 100rpm. Assume moderate shock conditions. 08

- (b) In a plate clutch, the axial force is 4500N. The inner radius of contact is 50mm and the outside radius is 100mm. Assuming uniform wear, Determine a) Maximum Pressure 2) Minimum Pressure 3) Average Pressure 04

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1. (a) A steel solid shaft transmitting 18kW at 300 rpm is supported on two bearing 700 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5mm module is located 110 mm to left of right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5mm module is located 160 mm to the right of left hand bearing and received power in vertical direction from below using an allowable shear stress of 54MPa in shear, determine diameter of shaft 10

Contd..

(b) What are the various types of stresses acting on the Key 02

2. Solve any TWO.

(a) Design a muff coupling for a shaft transmitting 25kW at 250 rpm. The safe shear stress for the plain carbon steel shaft is 50 N/mm^2 and for the cast iron muff it is 12 N/mm^2 . The allowable shear and crushing stresses for the keys material are 40 N/mm^2 and 80 N/mm^2 respectively. Design torque may be taken as 1.15 times the average torque. 06

(b) The spindle of a wood working machine runs at 1000rpm. It is mounted on two single row ball bearings, one of which is required to carry a radial load of 2250 N and thrust Load of 1900 N. The machine runs 8 hours per day. Assuming life of 4 years and spindle diameter equal to 30mm, select suitable bearing 06

(c) Design a flat belt drive to transmit 15kW at 720 rpm to driven machine operating at 360 rpm. Assume that belt slips over pulley by 3 percent. 06

3. (a) Design a journal bearing to carry a radial load of 3000N. The journal having 50mm diameter rotates at 1500 rpm. The viscosity of oil at operating temperature is 25MPa.s 10

(b) Define following terms 1) Rated life of bearing 02
2) Sommerfeld number

4. Solve Any ONE.

(a) A motor shaft rotating at 1440 rpm has to transmit 15kW power to a low speed shaft rotating at 500rpm. A 20° pressure angle involute tooth gear pinion is used. The pinion has 25 teeth. Both gear and pinion are made of cast iron having allowable strength of 55 N/mm^2 . Design Spur gear drive 12

(b) Design a pair of helical gears to transmit 30kW power at a speed reduction ratio of 4:1. The input shaft rotates at 2000 rpm. Take helix and normal pressure angles equal to 25° and 20° respectively. Both pinion and gear are made of steel. The number of teeth on pinion may be taken as 30. 12

5 (a) A roller chain is used in power plant to transmit 170kW from an engine to a generator. The generator speed is 560 rpm and engine speed is approximately 80 rpm. Design a chain drive. 08

(b) Design a suitable clutch for the speed gear box of lathe machine to transmit 15kW at 1000rpm. Due to space limitation, the outer diameter is limited to 150mm. 04

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1. (a) A shaft supported between two bearings placed 1.2m apart. A 0.60 m diameter pulley is mounted at a distance of 0.30 m to the right of the left hand bearing. This drives a pulley directly below it with the help of a belt having a maximum tension of 2.5kN. Another pulley 0.40 m in diameter is placed 0.20m to the left of right hand bearing and is driven with the help of electric motor and belt which is placed horizontal to the right. The coefficient of friction for the belt drives is 0.24 and angle of contact for both the pulleys is 180° . Determine suitable diameter of shaft. Take Shear stress for the shaft material as 62MPa. 10

(b) What are various types of stresses acting on key 02

2. Solve any TWO

(a) Design Protective type of CI flange coupling for a steel shaft transmitting 15kW at 200 rpm and having allowable shear stress of 40MPa. The working stress in the bolt should not exceed 30MPa. Same material is used for shaft and key. The shear stress for CI is 14MPa. 06

(b) An engine is transmitting 32kW at 460 rpm to a pump with a speed reduction of 2.5: 1. It is desired to use chain drive for this purpose. Design a roller chain 06

(c) A shaft rotating at 1440 rpm is supported by the two bearings. The forces acting on each bearing are 6000N radial load and 3500 N axial thrust. If the shaft diameter is 40 mm and the expected life of the bearing is 500hours. Select suitable bearing. 06

3. (a) Design a bearing and journal to support a load of 4500N at 600 rev/min using a hardened steel journal and a bronze baked babbit bearing. The bearing is lubricated by oil rings. Take room temperature as 21°C and oil temperature as 80°C 10

(b) On what factors the selection of a bearing for a particular application depends? 02

4. Solve Any ONE.

(a) A compressor is running at 300 rev/min is driven by 15kW, 1200 rev/min motor through a 14½° full depth gears. The centre distance is 0.375m. The motor pinion is forged steel hardened. Assuming medium shock condition, Design Spur gear drive. 12

(b) Design a pair of straight teeth Cast Iron bevel gears to transmit 90kW from a shaft running at 235rpm to another running at 75 rpm. Check for continuous operation. Assume a steady load. 12

5 (a) A diesel engine running at 500 rpm delivers 7.5kW to an agriculture pump running at 1200 rpm. The centre distance is 1meter. The diameter of diesel engine pulley is 400mm. Design a flat belt drive and pulley 08

(b) What is self actuating or self energizing brake? When a brake become self locking? 04