CBCS SCHEME

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18AU63

# Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
## Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 100

**Note: 1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***Use of Design data hand book is permitted.***
**3.** ***Any data, if necessary may suitably assume.***





### Module-1

**1** a. It is required to design a helical compression spring subjected to a maximum force of 1250 N. The deflection of the spring corresponding to the maximum force is 30mm. The spring index may be taken as 6. The spring is made of patented and cold drawn steel wire. The ultimate strength and modulus of rigidity of the spring material are 1090 N/mm$^2$ and 81370 N/mm$^2$ respectively. The permissible shear stress for spring wire may be taken as 50% of the ultimate tensile strength. Determine the following:
i) Wire diameter
ii) Mean coil diameter
iii) Number of active coils
iv) Free length of the spring **(10 Marks)**

b. A concentric spring for an aircraft engine valve is to exert a maximum force of 5000N under an axial deflection of 40mm. Both the spring have some free length, same solid length, and are subjected to equal maximum shear stress of 850MPa. If spring index for both the springs is 6, determine the load shared by each spring. **(10 Marks)**

**OR**

**2** a. A plate clutch consists of one pair of contacting surfaces. The inner and outer diameters of the friction disc are 100mm and 200mm respectively. The coefficient of friction is 0.1 and the permissible intensity of pressure is 1N/mm$^2$. Assuming uniform wear theory determine the power transmitting capacity of the clutch at 750rpm. **(06 Marks)**

b. A rope drum of an elevator having 650mm diameter is fitted with a brake drum of 1m diameter. The brake drum is provided with four cast iron brake shoes each subtending an angle of 45º. The mass of the elevator when loaded is 2000Kg and moves with a speed of 2.5m/s. The brake has a sufficient capacity to stop the elevator in 2.75m. determine :
i) Width of brake shoe, if allowable pressure is 0.3N/mm$^2$
ii) Heat generated in stopping the elevator.
Use $\mu = 0.2$. **(14 Marks)**

### Module-2

**3** a. A cast steel spur gear pinion ($\sigma_d$ = 138N/mm$^2$) having 21 teeth and rotating at 1500rpm is required to transmit 9kW to high grade cast iron gear ($\sigma_d$ = 56 N/mm$^2$) to run at 500rpm. The teeth are $14\frac{1}{2}^\circ$ involute. Determine the module, face width, pitch circle diameters of the pinion an gear using beam strength. **(10 Marks)**

b. A pair of spur gear is to transmit 15kW at 900rpm of forged steel pinion having design stress of 173MPa and 120mm diameter to a cast steel gear having a design stress of 138MPa which is to run at 300 rpm. Teeth are $14\frac{1}{2}^{\circ}$ involute form: Determine: i) Module ii) face width iii) Pitch circle diameter of gear and 4 Tangential tooth load. **(10 Marks)**

**OR**

**4** a. A pair of helical gear is to transmit 12kW at 1200rpm of pinion. The velocity ratio is 3:1. The pinion has 24 teeth and is made of carbon steel having design stress of 86MPa. The gear is made of cast steel having design stress of 51.7MPa. Teeth are $14\frac{1}{2}^{\circ}$ involute. Helix angle = 25º. Check the gear pair for dynamic load if module is 5mm. **(10 Marks)**

b. Two shafts inclined at 60ºare connected by a pair of bevel gears to transmit 9kW at 900rpm of 24 teeth cast steel pinion having design stress of 138MPa. The gear is made of cast iron and is to run at 300 rpm has a design stress of 103MPa. The teeth are $14\frac{1}{2}^{\circ}$ involute. Determine the virtual number of teeth on pinion and gear, module and pitch circle diameter of pinion and gear. **(10 Marks)**

## Module-3

**5** a. A 75mm long full journal bearing of diameter 75mm supports a load of 10kN. The speed of the journal is 1200rpm. the absolute viscosity of the oil is $10 \times 10^{-3}$ PaS and diametral clearance is 0.001. Determine the coefficient of friction using :

i) Petroff's equation
ii) Mackee equation. **(10 Marks)**

b. The load on the journal bearing is 150kN due to turbine shaft of 300mm diameter running at 1800 rpm. Determine :

i) Length of bearing if allowable bearing pressure is 1.6 N/mm$^2$
ii) Coefficient of friction **(10 Marks)**

**OR**

**6** a. Select a single row deep groove ball bearing for radial load of 8kN and axial load of 3kN. The shaft rotates at 1200rpm. The bore diameter of the bearing is to be 75mm and the bearing has to operate for 20,000 hours. **(10 Marks)**

b. The bearing receives an axial load of 1000N and radial load 2000N. The bearing operates for 10 hours a day, 5 days a week for 2 years. The shaft speed is 1000rpm. The shaft diameter is 35mm select a suitable ball bearing. **(10 Marks)**

## Module-4

**7** a. What is Piston slap and how do you control it. **(05 Marks)**

b. What are the functions of different type of piston rings? Explain. **(05 Marks)**

c. Using the following data of a single acting four stroke engine determine :

i) Dimensions of piston head
ii) Radial ribs

Cylinder bore = 100mm, Stroke = 125mm, Maximum gas pressure = 5N/mm$^2$,
Indicated mean effective pressure = 0.75N/mm$^2$, Mechanical efficiency = 80%,
Fuel consumption = 0.15Kg per brake power per hour,
Higher calorific value of fuel = $42 \times 10^3$kJ/Kg, Speed = 2000rpm. **(10 Marks)**

**OR**

**8** a. With the help of a neat sketch, explain the working of valve gear mechanism. **(05 Marks)**

b. Compare OHV and OHC valves. **(05 Marks)**

c. The conical valve of an IC engine is 60mm in diameter and is subjected to a maximum gas pressure of $4N/mm^2$. The safe stress in bending for the valve material is 46MPa. The valve is made of cast steel for which K = 0.42. The angle at which K = 0.42.The angle at which the valve disc seat is tapered is 30º. Determine :

i) Thickness of valve head

ii) Steam diameter. **(10 Marks)**

## Module-5

**9** a. An IC engine running at 1800rpm develops a maximum pressure of $3.15N/mm^2$. The diameter of piston is 100mm, length of connecting rod is 380mm, stroke of piston is 190mm, compression ratio is 6:1. The connecting rod is to be made of I-section. The constant in the numerator of Rankine formula is $320N/mm^2$ and the constant in the denominator is 1/7500. By taking a factor of safety of 6, determine the dimensions of cross section of the connecting rod. **(15 Marks)**

b. What is Whipping and what are its effects? **(05 Marks)**

**OR**

**10** a. With the help of a neat sketch, explain the construction of any one type of crank shaft. **(05 Marks)**

b. With the following data of a four stroke single cylinder engine design the crankshaft when it is at its dead center.

Bore diameter = 400 mm, Stroke = 600mm, Engine speed = 200rpm, Mean effective pressure = $0.5N/mm^2$, Maximum combustion pressure = $2.5N/mm^2$, Weight of the flywheel = 50kN, total belt pull = 6.5kN, when the crank has turned through 35º from the top dead center, the pressure on the piston is $1N/mm^2$. The ratio of the connecting rod length of crank ratio is 5. **(15 Marks)**

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