Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech**

Sub_Code: RME7D003

7th Semester Regular/Back Examination: 2025-26

SUBJECT: Design of Machine Components

BRANCH(S): MECH

Time: 3 Hours

Max Marks: 100

Q.Code: U172

Answer Q1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right-hand margin indicate marks. Prescribed Design Data Hand book is allowed.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What is the function of flywheel? State it's applications.

b) What is the criterion to distinguish between thin and thick cylinders?

c) What is the main advantage of overhung crankshaft?

d) What is virtual or formative helical gear?

e) What is internal expanding shoe brake? Where do you use it?

f) What are the advantages of involute teeth gears?

g) What are the advantages of helical gears over spur gears?

h) What is the coefficient of fluctuation of energy?

i) What are the design requirements of connecting rod?

j) Write down general procedure points to be adopted to solve a problem by the finite element method.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A gas cylinder with an internal diameter of 200 mm is subjected to an operating pressure of 10 MPa. It is made of plain carbon steel FeE 230 and the factor of safety is 2.5. Calculate the cylinder wall thickness assuming it to be a thin cylinder.

b) A pair of helical gears consists of 25 teeth pinion meshing with a 50 teeth gear. The normal module is 4 mm. Find the required value of the helix angle, if the center distance is exactly 165 mm.

c) Determine the dimensions of small and big end bearings of the connecting rod for a diesel engine with the following data:
Cylinder bore = 100 mm
Maximum gas pressure = 4 MPa
(l/d) ratio for piston pin bearing = 2
(l/d) ratio of crank pin bearing = 1.3
Allowable bearing pressure for piston pin bearing = 12 MPa
Allowable bearing pressure for crank pin bearing = 7.5 MPa

d) It is required to select a flat belt drive to connect two transmission shafts rotating at 800 and 400 rpm respectively. The center-to-center distance between the shafts is approximately 3 m and the belt drive is open type. The power transmitted by the belt is 30 kW and the load correction factor is 1.3. The belt should operate at velocity between 17.8 to 22.9 m/s. The power transmitting capacity of the belt per mm width per ply at 180^0 arc of contact and at a belt velocity of 5.08 m/s is 0.0147 kW. Specify the belt dimensions.

e) Briefly defined strain-displacement matrix relation in FEM.

f) A single plate clutch consists of only one pair of contacting surfaces. It is used for an engine, which develops a maximum torque of 120 N-m. Assume a factor of safety of 1.5 to account for slippage at full- engine torque. The permissible intensity of pressure is 350 KPa and the co-efficient of friction is 0.35. Assuming uniform wear theory, calculate the inner and outer diameters of the friction lining.

g) Pairs of spur gear consist of a 20 teeth pinion meshing with a 120 teeth gear. The module is 4 mm. Calculate

I. Centre distance
II. The pitch circle diameters of the pinion and gears
III. The addendum and dedendum
IV. The tooth thickness
V. The gear ratio

h) What are the assumptions made for the design of a center crank shaft?

i) A pair of worm gears is designated as, 1/30/10/8. Calculate

I. The Centre distances
II. Speed deduction
III. Dimensions of the worm

The dimensions of the worm wheel.

j) Describe the operation and use of internal expanding shoe brake with neat sketch.

k) A thick cylinder of internal diameter 160 mm is subjected to an internal pressure 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2, find the thickness required.

l) Explain the design procedure of a lever for a lever safety valve.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 A rimmed flywheel made of grey cast iron (mass density = 7100 kg/ mm^3) is used on a punching press running at a mean speed of 200 rpm. The punching operation consists of one-quarter revolution during which the flywheel is required to supply 3000 N-m of energy. The coefficient of speed fluctuations is limited to 0.2. The rim, which contributes 90% of the required moment of inertia, has a mean radius of 0.5 m due to space limitations. The cross-section of the rim is square. Determine its dimensions. **(16)**

Q4 It is required to design a V-belt drive to connect a 7.5 kW, 1440 rpm induction motor to a fan, running at approximately 480 rpm, for a service of 24 hr per day. Space available for a center distance of about 1 m. **(16)**

Q5 The following data is given for a four-stroke diesel engine: **(16)**
Cylinder bore = 250 mm, length of stroke = 300 mm, speed = 600 rpm, indicated mean effective pressure = 0.6 MPa, maximum gas pressure = 4 MPa, fuel consumption = 0.25 kg per BP per hr. Design the piston and assume suitable data wherever necessary.

Q6 It is required to design a pair of spur gears with 20^0 full-depth involute teeth consisting of a 20-teeth pinion meshing with a 50 teeth gear. The pinion shaft is connected to a 22.5 kW, 1450 rpm electric motor. The starting torque of motor can be taken as 130 % of the rated torque. The material for the pinion is plain carbon steel Fe 410 (S_{ult} = 410 N/mm^2), while the gear is made of grey cast iron FG 200 (S_{ult} = 200 N/mm^2). The factor of safety is 1.5. Design the gears based on the Lewis equation and using velocity factor to account for the dynamic load. **(16)**