CBCS SCHEME

USN | | | | | | | | | | |

15ME54

Fifth Semester B.E. Degree Examination, June/July 2019
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of design data hand book is permitted.*
3. *Assume missing data, if any, suitably.*

Module-1

1 a. Briefly discuss the factors influencing the selection of suitable material for machine elements. **(04 Marks)**

b. Determine the extreme fibre stresses at the critical section of the machine member loaded as shown in Fig.Q1(b). Also show the distribution of stresses at this section. **(12 Marks)**

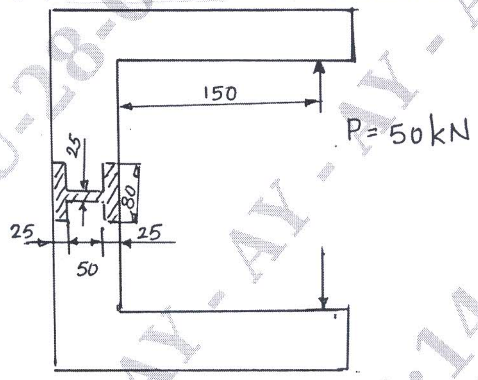

Fig.Q1(b) All dimensions are in mm.

OR

2 a. Give any three examples of stress raisers and show how the stress concentration can be reduced in these cases. **(06 Marks)**

b. A machine element loaded as shown in Fig.Q2(b). Determine the safe value of thickness of the plate. Material selected for the machine element has an allowable stress of 200 MPa.

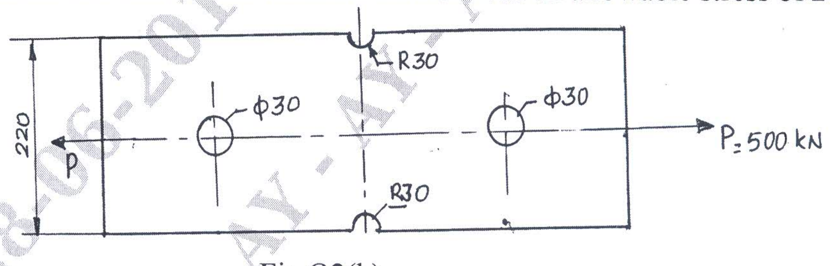

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Derive an expression for impact stress in a axial bar of c/s A and length 'L' due to the impact load of 'W' falling from a height 'h' from the collar. **(06 Marks)**

b. A steel cantilever beam of rectangular cross section is loaded 400 mm from the support. The width of the beam is 15 mm and depth is 20 mm. Determine the max bending stress in the beam, when a weight of 100 N is dropped on the beam through a height of 5 mm. Take E = 210 N/mm^2. **(06 Marks)**

c. Explain with neat sketches, the different types of varying stresses. **(04 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

4 a. Derive Soderberg's design equation for members subjected to variable stresses. **(06 Marks)**

b. A hot rolled steel shaft is subjected to a torsional load varies from 330 Nm clockwise to 110 Nm counter, clockwise and an applied bending moment varies from +440 Nm to −220 Nm. Determine the required shaft diameter. The ultimate strength of the material is 550 MPa and yield stress is 410 MPa. Take factor of safety as 1.5, endurance limit as half the ultimate strength and size factor as 0.85. Neglect the effect of stress concentration. **(10 Marks)**

Module-3

5 A steel shaft (C45) transmitting 15 kW at 210 rpm is supported between two bearings 1000 mm apart. On this, two spur gears are mounted. The gear having 80 teeth of module 6 mm is located 100 mm to the left of the right bearing and receives power from a driving gear such that the tangential force acts vertical. The pinion having 24 teeth and 6 mm module located 200 mm to the right of the left bearing and delivers power to a gear mounted behind it. Taking combined shock and fatigue factors 1.75 in bending and 1.25 in torsion, determine the diameter of the shaft. **(16 Marks)**

OR

6 a. Design a socket and spigot type of cotter joint for an axial load of 50 kN which alternately changes from tensile to compressive, assuming allowable stresses in the components under tension and compression as 52.5 MPa, bearing stress as 63 MPa and shearing stress as 35 MPa. **(08 Marks)**

b. Design a protected type cast-iron flange coupling for a steel shaft transmitting 30 kW at 200 rpm. The allowable shear stress in the shaft and key material is 40 MPa. The maximum torque transmitted is 20% greater than the full load torque. The allowable shear stress in the bolt is 60 MPa and allowable shear stress in the flange is 40 MPa. **(08 Marks)**

Module-4

7 a. Design a double riveted butt joint to connect two plates of 20 mm thick. The joint is zig-zag riveted and has equal width cover plates. The allowable tensile stress for the plate is 100 MPa. The allowable shear and crushing stresses for rivet material are 60 MPa and 120 MPa respectively. Calculate the efficiency of the joint so that the joint should be leak proof. **(08 Marks)**

b. Determine the size of rivets required for the bracket shown in Fig.Q7(b). Take permissible shear stress for the rivet material as 100 MPa.

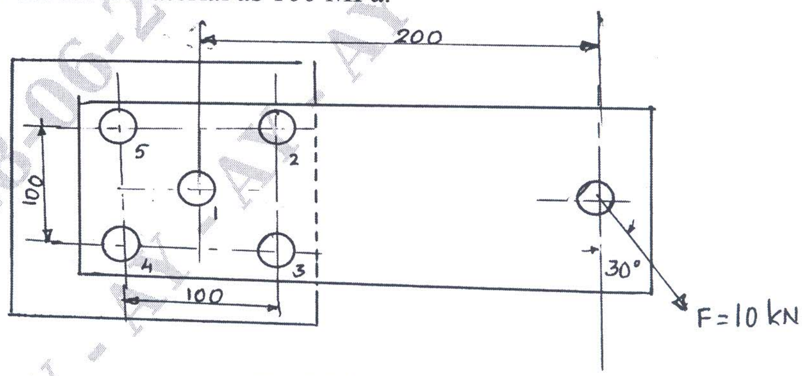

Fig.Q7(b) **(08 Marks)**

OR

8 a. A steel plate is welded by fillet weds to a structure and is loaded as shown in Fig.Q8(a). Calculate the size of the weld, if the load is 35 kN and allowable shear stress for the weld material is 90 MPa.

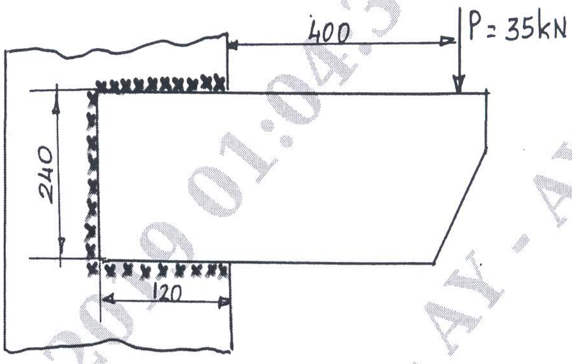

Fig.Q8(a) **(08 Marks)**

b. A circular beam, 50 mm in diameter is welded to a support by means of a fillet weld as shown in Fig.Q8(b). Determine the size of the weld, if the permissible shear stress in the weld is limited to 100 N/mm^2.

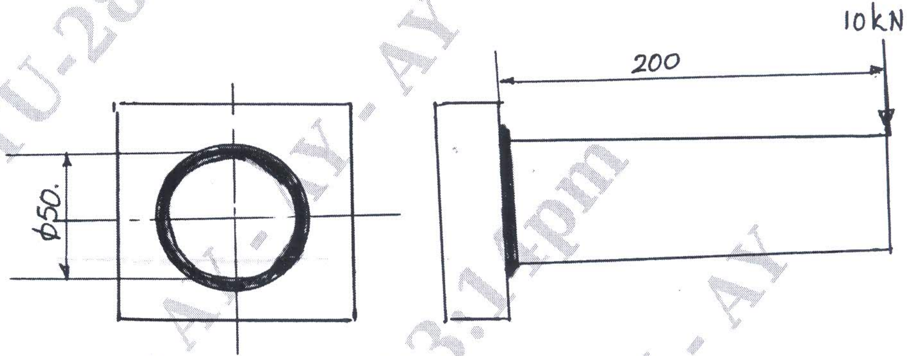

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Explain various types of stresses in threaded fasteners. **(04 Marks)**

b. A cylinder head is fastened to the cylinder of a compressor using 6 bolts of M20 size. Bolt material is C20 steel. The maximum fluid pressure is 3.5 MPa, cylinder diameter is 75 mm. A soft gasket is used. Assuming initial tension in each bolt is 40 kN, determine the factor of safety. **(12 Marks)**

OR

10 a. Derive an expression for torque required to lift the load on a square threaded screws. **(06 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double start. Load on the screw is 6 kN and the mean diameter of the thrust collar is 40 mm. The coefficient of friction for screw is 0.1 and for collar is 0.09. Determine:

i) Torque required to rotate the screw against the load.
ii) Torque required to rotate the screw with the load.
iii) Overall efficiency.
iv) Is the screw self-locking? **(10 Marks)**

* * * * *