Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

THIRD SEMESTER B.S. DEGREE EXAMINATION – OCT. / NOV. 2017

SUBJECT: DESIGN OF MACHINE ELEMENTS (ME232)

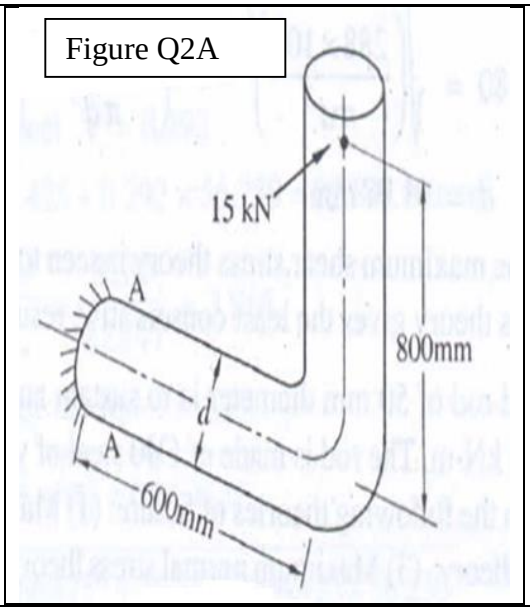
(BRANCH: MECHANICAL ENGINEERING)

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**
- ✓ **Use of Design Data Hand Book is permitted.**

1A.	Distinguish between a) ductility and brittleness. b) yield strength and ultimate strength. c) resilience and toughness. d) creep and fatigue. e) Standard and code f) static and dynamic load	**(12)**
1B.	Bending stress in a machine part fluctuates between tensile stress of 280 MPa and compressive stress of 140 MPa. What should be the minimum ultimate strength to carry this fluctuation indefinitely according to a) Gerber's formula b) Goodman's formula c) Soderberg's formula. The factor of safety can be taken as 1.75. Assume that the yield point is never likely to be less than 55% of ultimate tensile strength . Select appropriate material.	**(08)**
2A.	A bent steel rod of diameter d shown in Figure Q2A has a yield strength σ_{yp} 360 MPa. The material has a poisson's ratio 0.3. For a factor of safety 2, determine the diameter d using the following theories of failure. a) Maximum Normal stress theory. b) Maximum distortion energy theory. c) Maximum shear stress theory.	**(08)**

Figure Q2A



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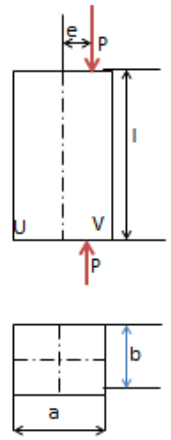
2B.	A rectangular bar of length 200 mm, breadth 50 mm and thickness 25 mm is subjected to an eccentric axial load of 10000 N . The eccentricity of the load from the axis is 10 mm. Determine the following. a) Principle stresses b) Maximum shear stress.  Figure Q 2B	**(12)**
3A.	Determine the inside and outside diameters of a hollow shaft which will replace a solid shaft made of the same material. The hollow shaft should be equally strong in torsion , yet weigh half as much per metre length.	**(10)**
3B.	A helical Valve spring is to be designed for an operating load range of 90N to 135 N. The 90N load acts when the valve is closed and 135 N force acts when the valve is open. The deflection of the spring is 7.5 mm. Use chrome- silicon steel . The ultimate tensile strength of Cr-Si steel is $\sigma_u=\frac{2000}{d^{0.112}}$. Density of steel 7800 kg/m^3.	**(10)**
4A.	A hollow shaft is required to transmit 500 kW power at 120 r.p.m. The maximum torque is 25% greater than the mean torque. The shaft is made up of plain carbon steel 45C8 (C-0.45% and Mn 0.8 %) with yield strength 380 MPa. and the factor of safety is 3.5. The shaft should not twist more than 1.5^0 in a length of 3 m. The internal diameter of the shaft is $\frac{3}{8}$ times the external diameter. The modulus of rigidity of the material of the shaft is 80 kN/mm^2. Determine the external diameter on the basis of shear strength and on the basis permissible angle of twist.	**(06)**
4B.	Draw a neat sketch of a spur gear and explain its nomenclature	**(14)**
5A.	A bearing , 50 mm in diameter and 75 mm long supports a overhang shaft running at 900 RPM. The room temperature is 30^0 C and bearing temperature is 75^0 C. The viscosity of oil is 0.012 kg/m-s at the operating temperature of 120^0 C. The diametral clearance is 0.05 mm and the bearing is to operate in still air, without any artificial cooling. K = 300 W/m^2 ^{0}C. Determine i) permissible load on the bearing and ii) power loss.	**(08)**
5B.	A cold drawn propeller shaft of a launch is to transmit 300 kW power at 1500 r.p.m. without being subjected to significant bending moment and slenderness ratio is 40. The efficiency of the propeller is 70% at 30 knots.(1 knot = 1.85 km/hr) Determine the diameter of the shaft if the permissible shear stress is 50 MPa. Ignore buckling effect.	**(08)**
5C.	Write note on any four types of keys used in light duty applications	**(04)**
6A.	Derive the expression for the effort (F)- load(W) ratio in a serew jack. Also show	**(10)**

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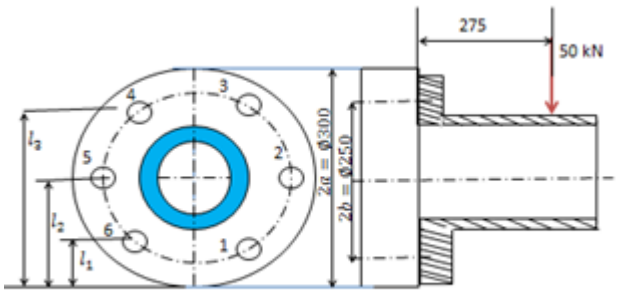
	the condition for overhauling of serew jack.	
6B.	Design a helical **tension** spring for a spring loaded safety valve so as to meet the following requirements. i) Diameter of valve seat = 70 mm ii) Operating pressure when the valve begins to lift = 0.7 MPa iii) Maximum pressure (when the steam blows off freely) = 0.75 MPa. iv) Lift of the valve during pressure change = 4mm v)Permissible shear stress τ=560 MPa. vi) G =0.84E5 MPa. vii) C = 6	**(10)**
7A.	The details of a machine shaft supported by deep groove ball bearings is given below. Design a suitable bearing. diameter d = 75 mm Working period 8 h x300 days x10 years. **Cycle i** | **fraction of cycle r_i** | **Radial Load F_r N** | **Axial Load F_i N** | **Speed N_i rpm** | **Working Condition** 1 | 0.25 | 3500 | 2000 | 1000 | steady 2 | 0.25 | 2500 | 2000 | 1500 | steady 3 | 0.5 | 4000 | 2000 | 800 | Light shock	**(10)**
7B.	A bearing shown in figure Q7B is fastened to a frame by 6 bolts spaced equally on a 250 mm diameter bolt circle on which two bolts are located on horizontal line of symmetry. The bearing flange diameter is 300 mm and a load of 50kN is applied at 275 mm from the frame. Determine the diameter of the bolts. The bolt is made of C20 steel with yield strength of 245 MPa . Take factor of safety n= 3  Figure Q7B	**(10)**
8A.	What is meant by interference in gears? How is it related to the number of teeth on a gear ? Justify your answer using a rack and pinion arrangement.	**(08)**
8B.	A load of 12kN is raised by a screw, with a single start square thread of 50mm mean diameter and 12 mm pitch. The screw is operated by a hand wheel, the boss of which is threaded to act like a nut. The load is resisted by a thrust collar, which supports the wheel boss and has a mean radius of 30mm. The coefficient of friction for screw is 0.15 and 0.18 for the collar. If the tangential force applied to the hand wheel is 120N, find the diameter of the hand-wheel required.	**(06)**

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8C.	A steel ball of 10 mm diameter is pressed on a flat steel plate by a force of 15 N. Take E = 210 GPa and Poisson's ratio 0.3 Calculate the following i) Geometric constant ii) Material constant iii) Contact patch radius iv) Maximum stress v) Average pressure	**(06)**

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