Code No: **09A51403**	R09	SET-1

B. Tech III Year I Semester Examinations, December-2011
PRINCIPLES OF MACHINE DESIGN
(MECHANICAL ENGINEERING(MECHATRONICS)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Compare the theories of failure by drawing the boundaries of their application for biaxial stress condition and explain their field of application.

b) A round steel rod is subjected to axial tension of 50 MPa with superimposed torsion of 100 MPa. What is your best prediction of the safety factor with respect to yielding if the material has a tensile strength of 500 MPa? [10+5]

2.a) Draw and explain S-N Curve? What is the difference between S-N Curve for ferrous and non-ferrous components?

b) A rotating bar made of steel 45C8 with ultimate strength of 630 MPa is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 MPa. Draw the S-N curve. Calculate the fatigue strength of the bar for a life of 90,000 cycles. [7+8]

3.a) Find out the inclination of the plane of maximum shear stress in the transverse fillet weld. Also find the expression for the maximum shear stress.

b) Compare the strength of the Transverse and Parallel fillet welds. [12+3]

4. A 75 mm countershaft in a machine shop transmits 39 kW at 315 rev/min. It is made of cold rolled steel with ultimate tensile strength of 490.0 MPa and yield strength of 310 MPa. It is supported on bearings 1.50 m apart. It has two pulleys mounted upon it. One is 0.45 m in diameter and is located 0.38 m to the right of left hand bearing and it receives power in a horizontal direction from a pulley to its right. The other pulley is 0.635 m in diameter, is located 0.45 m to the left of the right hand bearing and delivers power in a vertical direction to a machine below it. For k_b= 1.75 and k_s= 1.25, find the stress in the shaft and compare it with the design stress as obtained from the code. [15]

5.a) Write short notes on (i) Surging of the spring, (ii) Buckling of the compression spring.

b) A load of 5 kN is dropped from a height of 50 mm axially on the spring of a wire of diameter 12 mm, spring index equal to 6 and the number of active coils as 8. Find the stresses induced in the spring. [8+7]

6. Design a flat belt horizontal drive for transmitting 5.8 kW at 1400 rpm of motor. Speed of the driven pulley is 450 rpm and the maximum permissible peripheral speed is 16 m/s. Assume 3% creep, load factor =1.2, density of the belt material = 980 kg/m^3 , modulus of elasticity for the belt material = 100 MPa , Ultimate

tensile strength = 25 MPa, centre distance =2.8 m and endurance limit for the belt material = 4 MPa. [15]

7.a) Compare the sliding and rolling contact bearings.

b) A bearing, supporting a power transmitting shaft, is subjected to 3000N radial load and 45000N axial thrust. The shaft rotates at 400r.p.m and the expected life of the bearing is 10,000hours. Select a suitable bearing, if the diameter of the shaft is 40mm. [5+10]

8.a) Explain the importance of Lewis form factor in designing the spur gear. Derive the equation of beam strength of spur gear.

b) In a spur gear drive the diameter of pinion is 80 mm and the centre distance is 160 mm. The power to be transmitted is 4.5 kW at 800 rpm of pinion. Using 20^0 full depth teeth and material for pinion steel with permissible static bending stress of 200 MPa and for gear a steel with a permissible static bending stress of 150 MPa, determine the necessary module and width of the teeth. [5+10]

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B. Tech III Year I Semester Examinations, December-2011
PRINCIPLES OF MACHINE DESIGN
(MECHANICAL ENGINEERING(MECHATRONICS))

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. A short hollow cylindrical column of 200 mm inner diameter and 300 mm outer diameter carries a vertical eccentric load of 500 kN, in one of the diametric planes; the eccentricity being 100 mm. Determine the maximum intensity of the stress induced and state of stress in nature. What is the maximum permissible eccentricity of the above load, if the stress induced throughout the cross section is to be compressive in nature? [15]

2.a) What is notch sensitivity factor? What is the physical significance if the notch sensitivity is equal to one and zero?

b) A rectangular plate, 50 mm width, has a central hole with 10 mm diameter. The plate is subjected to a completely reversed axial load of 30 kN. It is made of steel 20C8 with ultimate tensile strength 440 MPa. The notch sensitivity factor is 0.8 and the expected reliability is 90%. The factor of safety is 2. Consider size factor of 0.85. Determine the plate thickness for an infinite life. [5+10]

3.a) Sketch and explain the various types of Rived Joints.

b) A single riveted lap joint is made in 15 mm thick plates with 20 mm diameter rivets. Determine the strength of the joint, if the pitch of the rivets is 60 mm. The permissible working stresses are 120 MPa in tension, 90 MPa in shear and 160 MPa in crushing. Find the efficiency of the joint. [8+7]

4.a) What do you mean by torsional rigidity?

b) A steel shaft 1.5 m long between bearings carries 1000 N pulley at its mid point. The pulley is keyed to the shaft and receives 20 kW at 200 rev/min. The belt drive is horizontal and the ratio of the belt tensions is 3:1. The diameter of the pulley is 600 mm. The load is applied with moderate shocks. Calculate the necessary diameter of the shaft. [7+8]

5. A concentric spring is used as a valve spring in a heavy duty diesel engine. It consists of two helical compression springs having the same free length and same solid length. The composite spring is subjected to a maximum force of 6000 N and the corresponding deflection is 50 mm. The maximum torsional shear stress induced in each spring is 800 MPa. The spring index of each spring is 6. Assume same material for two springs and the modulus of rigidity of spring material is 81370 MPa. The diametral clearance between the coils is equal to the difference between their wire diameters. Calculate (i) the axial force transmitted by each spring. (ii) Wire and mean coil diameters of each spring and (ii) number of active coils in each spring. [15]

6. A V belt drive is used to transmit 80 kW at a motor speed of 1000 rpm, the driven pulley speed being 600 rpm. Approximate centre distance = 1.11 m , Coefficient of friction = 0.3, angle of groove = 40^0 , and the maximum permissible peripheral speed is 25 m/s. Neglecting the centrifugal tension calculate the size and the number of belts. Also check the induced stress and find the life of the belt assuming endurance limit is 9 MPa. [15]

7.a) Differentiate between (i) Thick film and Thin film lubrication, (ii) Hydrodynamic and Hydrostatic bearings, (iii) Bearing Characteristic number and Bearing Modulus.

b) A 3 kN load is supported by a journal bearing of 75 mm diameter and 75 mm length. Diametral clearance 0.05 mm and bearing is lubricated by an oil of viscosity 0.0207 PaS at operating temperature. Determine the maximum speed of rotation of bearing when it is capable of dissipating 80 W by heat transfer. [9+6]

8.a) Write the expression for static strength, limiting wear load and dynamic load for helical gears and explain the various terms used.

b) Two precision cut forged helical gears have 200 full depth involute teeth. The angle of helix is 230. Permissible static bending stress is 100MPa, module 3mm, face width 500mm. The speed of rotation of pinion is 900rpm with gear ratio 5:1, surface endurance strength is 630MPa. Find the transmitted and wear load and state whether the design is safe. [7+8]

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Code No: **09A51403** | R09 | SET-3

B. Tech III Year I Semester Examinations, December-2011
PRINCIPLES OF MACHINE DESIGN
(MECHANICAL ENGINEERING(MECHATRONICS))

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Derive the relationship between the yield strength in shear and the yield strength in tension using the Distortion energy theory.

b) A machine element is subjected to principal stresses of 120 MPa, 0 MPa and -90 MPa. The material used is 30C8. Calculate the factor of safety by (a) the maximum normal stress theory, (b) the maximum shear stress theory and (c) the Distortion energy theory. [6+9]

2.a) What is fatigue stress concentration factor? In what way, it is different from the theoretical stress concentration factor.

b) A machine part is made of forged steel with ultimate strength of 630 MPa and endurance strength is 0.22 times ultimate strength. The life of the part is 250000 cycles. The loading for the 50% of the time is ± 225 MPa and for 30% of the time is ± 145 MPa. Calculate the loading during the remaining time. [6+9]

3.a) Show by neat sketches the various ways in which a riveted joint may fail.

b) A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. The permissible working stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing. Find the minimum force per pitch which will rupture the joint. [9+6]

4.a) Explain under what circumstances hollow shafts are preferred over solid shafts.

b) A section of commercial shafting 2 m long between bearings carries a 1000 N pulley at its midpoint. The pulley is keyed to the shaft and receives 30 kW at 150 rev/min. The belt drive is horizontal and the sum of the belt tensions is 8000 N. Assume $k_t = k_b = 1.5$. Calculate the necessary shaft diameter and determine the angle of twist between bearings. G= 80 GN/m^2. [4+12]

5.a) Derive expression for deflection of the close coiled helical spring and from that the expression for stiffness of the spring.

b) The blow off pressure for a safety valve is 1.2 MPa with the maximum lift of the valve as 10 mm. The valve of diameter 69 mm is loaded with a spring of spring index 5.5 and an initial compression of 40 mm. Maximum permissible shear stress for the spring material is 500 MPa and G = 80 GPa. Design the spring. [6+9]

6.a) What are the advantages of the V-belts over flat belts?

b) It is required to design leather cross belt drive to connect 7.5 kW, 1440 rpm electric motor to a compressor running at 480 rpm. The distance between the

centers of the pulleys is twice the diameter of the bigger pulley. The belt should operate at 20 m/s approximately and its thickness is 5 mm. Density of leather = 950 kg/m^3 and ultimate strength = 25 MPa. [6+9]

7. Design a journal bearing required to resist a radial load of 8 kN. The oil used has a viscosity of 0.0087kg/m-s at the operating temperature of 800C. Shaft speed is 720r.pm. Bearing diametral clearance may be assumed as 0.00025mm per mm diameter, and ambient temperature is 300C. If heat radiating capacity of the bearing is 150N-m /sec/m2 of projected area of bearing per 0^C ; determine whether artificial cooling is necessary? [15]

8.a) What is the herringbone gear? Where are they used?

b) A helical cast steel gear with 30o helix angle has to transmit 35kW at 2000 rpm. If the gear has 25 teeth, find the necessary module, pitch diameters and face width for 200 full-depth involute teeth. The static stress for cast steel may be taken as 100MPa. The face width may be taken as 3 times the normal pitch. The tooth form factor is given by expression y=0.154-0.912 /TE, where TE represents the equivalent number of teeth. The velocity factor is given by Cv = 6/ (6+V) where V is the peripheral speed of the gear in m/s. [3+12]

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Code No: **09A51403**	R09	SET-4

B. Tech III Year I Semester Examinations, December-2011
PRINCIPLES OF MACHINE DESIGN
(MECHANICAL ENGINEERING(MECHATRONICS))

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) What is factor of safety? Why is it necessary to use factor of safety?
b) An internally pressurized section of round steel tubing is subjected to tangential and axial stresses at the surface of 200 and 100 MPa respectively. Superimposed on this is a torsional stress of 50 MPa. What maximum shear stress is experienced by the outer surface? Evaluate the maximum shear stress from Tresca's criteria also? [6+9]

2.a) Draw and explain Soderberg, Goodman and Gerber diagrams.
b) A steel rod is subjected to a tensile load which varies from 40 kN to 120 kN. Find the safe area of the bar. Take factor of safety = 2, Yield point of the material = 570 MN/m^2 and endurance limit of the material = 350 MN/m^2. [9+6]

3.a) List the assumptions made in the design of boiler joints.
b) Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa; compressive stress 140 MPa; and shear stress in the rivet 56 MPa. [3+12]

4.a) Differentiate between a cotter and a key.
b) Design a sleeve and double cotter joint to be designed for connecting two steel rods. An axial tensile load of 30000N acts on the rods. Permissible stresses. σ_t = 55 MPa, σ_c= 70MPa and τ = 40MPa. [4+11]

5.a) What are the functions of springs? Give examples for each function.
b) A helical compression spring having a free length of 350 mm exerts a maximum force of 10 kN when compressed by 80 mm. Maximum value of the outside diameter of the spring is 180 mm. Find the wire diameter, mean coil diameter and number of active turns. Permissible shear stress = 240 MPa. Modulus of rigidity = 80 GPa. [6+9]

6.a) How are the chain drives classified?
b) Design a chain drive to actuate a compressor from 15kW electric motor running at 1000 rpm. The compressor speed is 350 rpm. The minimum center distance is 500mm. The compressor operates 16 hrs/day. The chain tension is adjusted by shifting the motor on slides. [4+11]

7.a) Explain the various types of lubrication?

b) A 310 deep groove ball bearing has a work cycle with 1000 rpm for one-third of the time, 2000 rpm for the next one third of the time, and 4000 rpm for the last one-third of the time. The outer race of the bearing rotates. The radial load is 3.5kN and axial load is 2kN. Determine the expected average life in hours, if the basic dynamic capacity of the bearing is 47 kN. [5+10]

8.a) Explain why helical gears are capable of transmitting greater power at high speed as compared to the spur gear.

b) A pair of helical gears have 20^0 stub teeth in diametral plane and helix angle is 45^0. The power to be transmitted is 20 kW. The pinion rotates at 5000 rpm and has 30 teeth. The gear ratio is 5. The material for gears is cast steel with safe bending stress of 110 MPa. BHN of the material is 250. Design the gear using Lewis Equation and check it for wear strength. [3+12]

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