BE Semester-VIII (MECHANICAL ENGG) Question Bank

(MACHINE DESIGN)

All questions carry equal marks (10 marks)

Q.1	Explain standard system of gear tooth and advantage and disadvantages of 14.50 and 20 degree involutes system.
Q.2	Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.
Q.3	Why an I-section is usually preferred to round section in case of connecting rods?
Q.4	A single-row deep groove ball bearing No. 6002 is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. [Static load capacity C_o: 2500 N, Dynamic Load Capacity C: 5590N]
Q.5	Classify and explain the material handling equipments.
Q.6	Differentiate between involute and cycloidal profile of the gears.
Q.7	Explain: Bearing characteristic curve.
Q.8	Explain the procedure of designing multi speed gear box.
Q.9	Explain: various terms used in sliding contact bearing with neat sketch.
Q.10	Explain: Design procedure for rocker arm and valve gear mechanism.
Q.11	Explain Wire ropes with its designation. What are the advantages of wire ropes. Explain selection of wire ropes.
Q.12	Why trapezoidal section is used for hook? Draw a neat sketch of single hook and Show the critical section on it.
Q.13	Explain design procedure designing belt conveyors.
Q.14	Classify the conveyors. Explain construction and working of any one conveyor.
Q.15	The following data refer to 3600 hydrodynamic journal bearing: Journal speed = 900 rpm End leakage factor = 0.002 Journal diameter =50 mm Bearing length = 100 mm Diametral clearance = 0.001 bearing pressure = 1.4 N/mm2 Absolute Viscosity of lubricant = 0.011 kg/m-sec at 750^0C operating temperature Room temperature = 35^0C Inlet temperature of the oil =10^0C Specific heat of the oil = 1850 J/k/^{0}C Heat dissipation Coefficient = 280 W/m^2/^{0}C Calculate: (i) The amount of artificial cooling required (ii) the mass of the Lubricating oil required.

Q.16	Two shafts at right to each other are connected by a bevel pair having full depth involute teeth. The pinion having 20 teeth transmits 40 kW at 750 rpm to gear shaft running at 375 rpm. Take allowable static stress for pinion and gear materials 100 N/m^2 and 70 N/mm^2 respectively. Determine module, pitch diameters and face width
Q.17	Following data refer to a 4-stroke petrol engine: Brake power=7.5 KW, Indicated mean effective pressure=0.45 N/mm^2 ,Maximum explosion pressure=3.2 N/mm^2 , Mechanical efficiency = 80% ,Allowable stress for C.I. cylinder =40 MPa , Allowable stress for Ni-steel bolt = 70 N/mm^2 , Find:1) Bore and Stroke of engine taking L/D=1.25 , 2) Thickness of cylinder wall and flange , 3) Size and number of bolts required to join the cylinder head.
Q.18	Design a crane hook for lifting capacity of 5 tones. It is made from forged steel and has triangular section. Take permissible tensile stress 80 N/mm^2.Assume standard data to standardize the dimension of hook.
Q.19	Design a suitable speed gear box for a head stock of a lathe that has a variation of speed from 105 r.p.m. to 690 r.p.m. in 9 steps. The power is supplied by an electric motor of 10 KW capacity running at 1000 r.p.m. and having driving the input shaft through a V-belt drive having speed ratio of 2 **:** 1 . Draw the structural diagram , speed chart and determine the number of teeth on each gears.
Q.20	Design a connecting rod for a petrol engine from the following data: Diameter of piston = 110 mm; Mass of reciprocating parts = 2 kg; Length of connecting rod = 325 mm; Stroke = 150 mm; Speed = 1500 rpm with possible over speed of 1850 rpm; Compression ratio = 4:1; Factor of safety = 4; Maximum explosion pressure = 5.5 MPa Select suitable material and permissible stresses for its.
Q.21	Draw speed ray diagram and layout for a six speed gear box .The out put speed are 160 r.p.m. minimum and 1000 r.p.m. maximum. The motor speed is 1440 r.p.m.
Q.22	A pair of helical gears having a transmission ratio 8:3 , with a steady load condition, used for turbine. The maximum speed is 2400 r.p.m. The pinion is to have 27 teeth and a face width of 100 mm. The circular module is 6 mm. The material used for gears is heat treated steel with 250 BHN and have

	static stress of 210 MPa. The gears are carefully cut. Calculate value of dynamic load and wear load.
Q.23	Determine the power capacity of a pair of helical turning gears having a transmission ratio of 10:1. The teeth are 20^{o} full depth involute – 6 mm module . The pinion has 25 teeth and rotates at 5000 r.p.m. The active face width is 76 mm and material is C-40 steel untreated.
Q.24	Determine the principle dimensions of cylinder for a vertical 4 stroke compression ignition engine from the following data: Brake power = 4.5 kW, Speed = 1200 rpm, Indicated mean effective pressure = 0.35 MPa, Mechanical efficiency = 80%.
Q.25	Design a connecting rod for a high speed diesel engine from the following data: Cylinder bore = 100 mm,Stroke = 120 mm,Maximum speed = 1800 rpm,Compression ratio = 18,Max. Explosion pressure = 5 MPa, Mass of reciprocating parts = 3.5 Kg, Length of connecting rod = 240 mm, If the connecting rod is made of drop forged steel, determine the size of I-section, size of small end bearing, big end bearing and bolts. Assume suitable stresses.
Q.26	A three stage gear box with twelve speeds is to be designed based on R10 series with minimum spindle speed of 125 rpm. The second stage consists of three speed steps. The electric motor is connected to the gear box through a belt drive and runs at 1440 rpm and transmits of 5 kW. Using standard spindle speeds, 1. Draw the structure and speed diagram for the arrangement. 2. Determine the ratio of the belt pulley diameters. 3. Draw the gear box layout. 4. Determine the number of teeth on each gear of the gear box.
Q.27	A pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 rpm and supplying 12 kW power to a gear. The speed reduction is 4:1. The normal pressure angle and helix angle are 20^{0} and 23^{0} respectively. Both gears are made of hardened steel (S_{ut} = 600 N/mm^{2}). The service factor and factor of safety are 1.5 and 3 respectively. Calculate

	1. Module and face width of gears. 2. Surface hardness for the gears assuming a factor of safety of 1.5 for wear consideration.
Q.28	It is required to design a pair of bevel gears, which are mounted on shafts intersecting at right angles. The pinion receives 20 kW power through its shaft and rotates at 720 rpm. The number of teeth on pinion and gear are 30 & 45 respectively. The pressure angle is 20° full depth teeth form. The gears are made of plain carbon steel with permissible bending stress as 200 MPa. The gears are case hardened and the surface hardness is 300 BHN. Take service factor = 1.25.
Q.29	Design a plain carbon steel centre crankshaft for a single acting four stroke, single cylinder engine for the following data: Piston diameter = 250 mm; Stroke = 400 mm; Maximum combustion pressure = 2.5 MPa; Weight of the flywheel = 5 kg; Total belt pull = 100 N; Length of connecting rod = 950 mm. The flywheel is used as a pulley. When the crank has turned through 30^0 from top dead centre, the pressure on the piston is 1 MPa and the torque on the crank is maximum. Any other data required for the design may be assumed.
Q.30	Design a single rope drum to transmit a torque of 8 kN.m with a 32 mm rope. Assume the height of the load to be raised as 2**.**7 meter and the ratio of the pulley system as 2. The mean diameter of the drum is 576 mm. Assume the drum to be made of Grey cast iron, grade 20 having allowable shear strength of 33 MPa. Make a neat sketch of the arrangement.
Q.31	Design a pair of helical gears to transmit 50 kW at a speed of 1440 rpm to a shaft required to run at 480 rpm. The helix angle is approximately 250 and 200 full depth teeth are used. Both the gear and pinion are made of steel with permissible stress 80 N/mm2 and 100 N/mm2 respectively. Take minimum number of teeth on pinion 16. Check your design for dynamic load and determine minimum hardness of teeth required.
Q.32	Two shafts at right to each other are connected by a bevel pair having full depth involute teeth. The pinion having 20 teeth transmits 40 kW at 750 rpm to gear shaft running at 375 rpm. Take allowable static stress for pinion and gear materials 100

	and 70 N/mm2 respectively. Determine module, pitch diameters and face width from strength considerations.
Q.33	Design a cast iron piston for a single acting four stroke diesel engine for following data: Cylinder bore = 100 mm, stroke = 125 mm, pmax = 5.8 N/mm2, pmean = 0.8 N/mm2, ηm = 85 %, speed = 1500 rpm, Fuel consumption = 0.16 kg/BP/hr, H.C.V. = 40 x 103 kJ/kg, Constant C = 0.05, K = 46.6 W/m/0K, σ t (C.I.) = 30 N/mm2 For piston : μ = 0.1, pb = 0.45 N/mm2 For piston rings: pw = 0.030 N/mm2 , σ t = 80 N/mm2 For piston pin: pb = 20 N/mm2, σ b = 120 N/mm2 , τ = 60 N/mm2.
Q.34	Design a connecting rod for a 4 – stroke petrol engine from the following data: Cylinder bore = 100 mm Stroke length = 140 mm Engine speed = 1500 rpm Possible over speed of engine = 2500 rpm Maximum explosion pressure = 2.5 MPa Weight of reciprocating parts = 18.5 N Length of connecting rod = 315 mm Yield strength of connecting rod material = 320 MPa Factor of safety = 5 Permissible bearing pressure for big end = 12.5 MPa Permissible bearing pressure for small end = 15 MPa
Q.35	A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 200, while the helix angle 250. The face width is 40 mm and the normal module is 40 mm. The pinion as well as the gear are made of steel 40C8 having ultimate tensile strength of 600 N/mm2 and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears

Q.36	A triple threaded worm rotating at 1200 r.p.m. drives a worm gear having 36 teeth and transmits 15 KW power . The teeth are of 20º full depth involute profile .The axial pitch of the worm is 30 mm and pitch diameter of 60 mm. The co-efficient of friction is 0.03. Calculate 1)Helix angle of worm 2) Speed ratio 3) Centre distance between two shafts , 4) Apparent stress in the worm gear. 5) Efficiency of drive.
Q.37	Explain: aesthetic considerations in design.
Q.38	Explain: ergonomics considerations in design.
Q.39	Give the comparison of sliding and rolling contact bearing.
Q.40	Explain the static load capacity, dynamic load capacity and equivalent dynamic load capacity.