3. Part B consists of 10 questions. Answer any 5 questions which carries 12M.
4. Each question carries 12marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks **(10x1M=10 Marks)**

1	Define Machine Design
2	What is stress concentration?
3	What are the types of butt joints in welding?
4	What is fatigue failure?
5	What is fillet joint?
6	Define Design Synthesis.
7	What are the functions of key?
8	What is sunk key?
9	What is coupling? Where do you use it?
10	What is the function of transmission shaft?

Part-B

Answer **ANY FIVE QUESTIONS** **(12MX 5=50Marks)**

11	The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory. Take permissible tensile stress at elastic limit = 100 MPa and Poisson's ratio = 0.3.
12	What are the general considerations in designing machine members? Discuss in detail.
13	A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m2 and – 150 MN/m2. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety = 2.

	Ultimate strength; and factor of safety = 2.
14	Explain the significance of Goodman's line and Soderberg line in design members subjected to reversal of stresses?
15	Explain the various ways in which a riveted joint may fail.
16	Find the efficiency of the riveted joint Single riveted lap joint of 6 mm plates wit 20 mm diameter rivets having a pitch of 50 mm. Assume Permissible tensil stress in plate = 120 MPa Permissible shearing stress in rivets = 90 MPa Permissible crushing stress in rivets = 180 MPa.
17	Design the rectangular key for a shaft of 50 mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa.
18	Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.
19	Design and draw a cottered foundation bolt which is subjected to a maximum pull of 50 kN. The allowable stresses are : σt = 80 MPa ; τ = 50 MPa ; and σc = 100 MPa
20	Design and make a neat dimensioned sketch of a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa.

1	Define strength
2	What is fatigue life?
3	Calculate series factor for R5.
4	What is reversed stress? Draw a stress–time curve for reversed stress.
5	What is a tap bolt?
6	What is transverse fillet weld?
7	How is keyway made?
8	What is sunk key?
9	How are commercial shafts made?
10	Describe Rigid Flange Couplings.

Part-B

Answer **ANY FIVE QUESTIONS** **(12MX 5=50Marks)**

11	A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using two different theories of failure, and assuming a factor of safety of 2. Take E = 210 GPa and poisson's ratio = 0.25
12	What are theories of failure? Explain any two theories of elastic failure for bi-axial loading system with the help of equations
13	A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design
14	1. Determine the diameter of a circular rod made of ductile material with a fatigue strength (complete stress reversal), σe = 265 MPa and a tensile yield strength of 350 MPa. The member is subjected to a varying axial load from Wmin = – 300 × 103 N to Wmax = 700 × 103 N and has a stress concentration factor = 1.8. Use factor of safety as 2.0.
15	A double riveted lap joint is made between 15 mm thick plates. The rivet diameter

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	and pitch are 25 mm and 75 mm respectively. If the ultimate 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. If the above joint is subjected to a load such that the factor of safety is 4, find out the actual stresses developed in the plates and the rivets.
16	The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm2. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.
17	A 45 mm diameter shaft is made of steel with a yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with a yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.
18	Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses : σt = 60 MPa ; τ = 70 MPa ; and σc = 125 MPa
19	A steel spindle transmits 4 kW at 800 r.p.m. The angular deflection should not exceed 0.25° per metre of the spindle. If the modulus of rigidity for the material of the spindle is 84 GPa, find the diameter of the spindle and the shear stress induced in the spindle
20	Two 35 mm shafts are connected by a flanged coupling. The flanges are fitted with 6 bolts on 125 mm bolt circle. The shafts transmit a torque of 800 N-m at 350 r.p.m. For the safe stresses mentioned below, calculate 1. diameter of bolts ; 2. thickness of flanges ; 3. key dimensions ; 4. hub length; and 5. power transmitted. Safe shear stress for shaft material = 63 MPa Safe stress for bolt material = 56 MPa Safe stress for cast iron coupling = 10 MPa Safe stress for key material = 46 MPa.

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4. Each question carries 12marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks **(10x1M=10 Marks)**

1	What is fluctuating stress? Draw a stress–time curve for fluctuating stress
2	Define Toughness
3	What is low-cycle fatigue?
4	What is butt joint in Welding?
5	Graphically represent Sequential Design Process.
6	What is feather key?
7	What is a cap screw?
8	What is a knuckle joint?
9	What is coupling? Where do you use it?
10	What is the difference between rigid and flexible couplings?

Part-B

Answer **ANY FIVE QUESTIONS** **(12MX 5=50Marks)**

11	A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. The maximum shear stress; and 2. The maximum distortion strain energy theory of yielding.
12	What are the general considerations in designing machine members? Discuss in detail.
13	2. A steel rod is subjected to a reversed axial load of 180 kN. Find the diameter of the rod for a factor of safety of 2. Neglect column action. The material has an ultimate tensile strength of 1070 MPa and yield strength of 910 MPa. The endurance limit in reversed bending may be assumed to be one-half of the ultimate tensile strength. Other correction factors may be taken as follows: For axial loading = 0.7; For machined surface = 0.8 ; For size = 0.85 ; For stress

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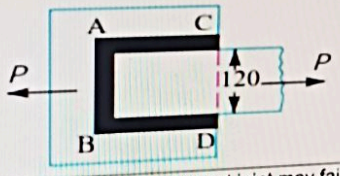
	concentration = 1.0.
14	Explain the significance of Goodman's line and Soderberg line in design of members subjected to reversal of stresses?
15	1. Determine the length of the weld run for a plate of size 120 mm wide and 15 mm thick to be welded to another plate by means of 1. A single transverse weld; and 2. Double parallel fillet welds when the joint is subjected to variable loads 
16	Explain the various ways in which a riveted joint may fail.
17	Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate strength of the material of the rod against tearing is 420 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6.
18	Design the rectangular key for a shaft of 50 mm diameter. The shearing and crushing stresses for the key material are 42 MPa and 70 MPa.
19	A solid shaft is transmitting 1 MW at 240 r.p.m. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 60 MPa
20	Design and make a neat dimensioned sketch of a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 r.p.m. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa.

3. Part B consists of 10 questions. Answer any 5 questions which carries 12M.
4. Each question carries 12marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks **(10x1M=10 Marks)**

1	What is reliability factor?
2	Graphically represent caulking?
3	How will you designate magnitude of tolerance?
4	What is fatigue life?
5	What is the common material for rivet?
6	What is meant by Standardization in Design?
7	What is a cotter joint?
8	What is taper sunk key?
9	How are commercial shafts made?
10	Describe Rigid Flange Couplings

Part-B

Answer **ANY FIVE QUESTIONS** **(12MX 5=50Marks)**

11	What are theories of failure? Explain any two theories of elastic failure for bi-axial loading system with the help of equations.
12	The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to 1. Maximum principal stress theory; 2. Maximum shear stress theory. Take permissible tensile stress at elastic limit = 100 MPa and Poisson's ratio = 0.3.
13	A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors of 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis

	for design.
14	Explain the significance of Goodman's line and Soderberg line in design of members subjected to reversal of stresses?
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16	The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm2. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.
17	Design and draw a cottered foundation bolt which is subjected to a maximum pull of 50 kN. The allowable stresses are : σt = 80 MPa ; τ = 50 MPa ; and σc = 100 MPa
18	Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.
19	Two 35 mm shafts are connected by a flanged coupling. The flanges are fitted with 6 bolts on 125 mm bolt circle. The shafts transmit a torque of 800 N-m at 350 r.p.m. For the safe stresses mentioned below, calculate 1. diameter of bolts ; 2. thickness of flanges ; 3. key dimensions ; 4. hub length; and 5. power transmitted. Safe shear stress for shaft material = 63 MPa Safe stress for bolt material = 56 MPa Safe stress for cast iron coupling = 10 MPa Safe stress for key material = 46 MPa.
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