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B. TECH
(SEM-V) THEORY EXAMINATION 2020-21
MACHINE DESIGN-I

Time: 3 Hours

Total Marks: 70

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 7 = 14

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| a. | What are preferred numbers? Explain their application in standardization. |
| b. | Define 'Engineering design'. Explain the basic procedure for mechanical engineering design |
| c. | What is meant by stress concentration? |
| d. | Describe notch sensitivity and Endurance limit in brief |
| e. | What are desirable properties of material for designing the shaft? |
| f. | Define Solid length, Spring Index and free length of spring. |
| g. | Mention the application area of square , flat and rectangular keys. |

SECTION B

2. Attempt any three of the following:

7 x 3 = 21

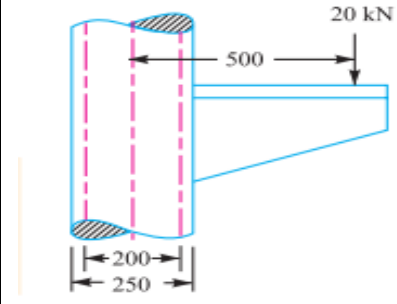
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| a. | A cylindrical shaft, made of steel having yield strength 760 N/mm^2 , is subjected to a static load consisting: bending moment of 15 N-m and torsional moment of 25 KN--m. If the required factor of safety is 2.5 determine the diameter of shaft using (i) The maximum shear stress theory (ii) The maximum strain energy theory. Assume $E=200 \text{ GPa}$ and $\mu=0.25$ |
| b. | A plate of 110 mm width is subjected to a tensile load that has a maximum value of 250000 N and a minimum value of 10000 kgf. If the factor of safety required is 1.5. Using Soderberg formula, determine the thickness of the plate. The properties of plate material are (i) Endurance limit= 22500 N/cm^2 yield stress= 30000 N/cm^2 |
| c. | Explain two theories of failure used in design of shaft. |
| d. | A helical compression spring, made of 50C4 has an outside diameter of 80 mm and a wire diameter of 12 mm. The maximum load acting on spring is 1 KN. The spring has flat and ground ends with 10.5 coils. If the modulus of rigidity of spring material is $0.89 \times 100 \text{ KN/mm}^2$. Determine (i) The maximum stress induced in spring (ii) The maximum deflection of spring (iii) The factor of safety available |
| e. | A square key is used for fixing a pulley on a shaft of 50 mm diameter. The pulley rotates at 200 r.p.m and transmits 10 KW power to shaft. The key is made of steel 45 C8 ($S_{yt} = S_{yc} = 380 \text{ N/mm}^2$ and $S_{ys} = 0.577 S_{yt}$). If the factor of safety is 3. Design the Key |

SECTION C

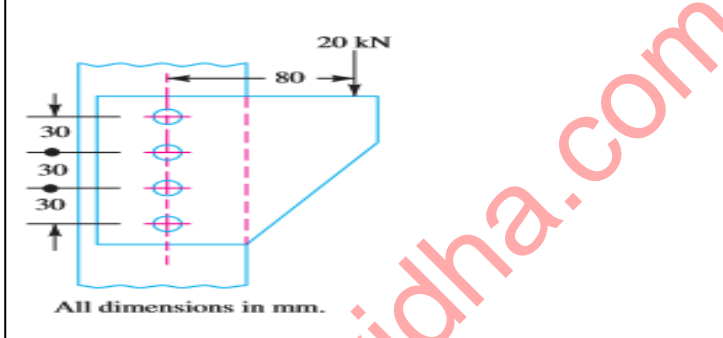
3. Attempt any one part of the following:

7 x 1 = 7

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| (a) | Discuss the factors that govern the selection of material in machine design. |
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| (b) |  | <p>A hollow circular column of external diameter 250 mm and internal diameter 200 mm, carries a projecting bracket on which a load of 20 kN rests, as shown in figure. The centre of load from the centre of column is 500 mm. Find the stresses at the sides of the column</p> |
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4. Attempt any *one* part of the following: 7 x 1 = 7

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| (a) | <p>A double riveted lap joint is made out of 16mm thick plate. Find the maximum force per pitch length which will rupture the joint assuming the following stress $\sigma_t = 400$ MPa, shear stress = 320 MPa, $\sigma_c = 640$ MPa. What would be the actual stresses developed in joint, if a factor of safety of 4 is used?</p> |
| (b) | <p>A bracket is supported by means of 4 rivets of same size as shown in figure. Determine the diameter of the rivet if maximum shear stress is 140 MPa.</p> <div style="text-align: center;">  <p>All dimensions in mm.</p> </div> |

5. Attempt any *one* part of the following: 7 x 1 = 7

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| (a) | <p>A solid shaft is subjected to a bending moment of 3.46 kN-m and torsional moment of 11.5 kN-m. The shaft is made of 45C8. If the required factor of safety is 6. Determine the diameter of shaft.</p> |
| (b) | <p>A line shaft rotating at 200 r.p.m is to transmit 200 kW power. The shaft carries a central load of 900 N and is simply supported between bearings 3 m apart. The allowable shear stress for the shaft is 42 N/mm² while allowable tensile stress for the shaft is 56 N/mm². Determine the diameter of shaft.</p> |

6. Attempt any *one* part of the following: 7 x 1 = 7

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| (a) | <p>Explain design procedure of helical compression and tension springs</p> |
| (b) | <p>A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 600 N to 1600 N. The spring index is 6 and design factor of safety is 1.43. If the yield shear stress is 700 MPa and the endurance stress is 350 MPa. Find the size of spring wire and mean diameter of spring coil</p> |

7. Attempt any *one* part of the following: 7 x 1 = 7

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| (a) | <p>A bolt with a square threaded screw has a mean diameter of 25 mm and pitch of 3 mm. It carries an axial thrust of 10kN on a bolt head of 25 mm mean radius. If the coefficient of friction is 0.12. Determine the force required at the end of spanner of 450 mm long in lightening up the bolt.</p> |
| (b) | <p>A screw jack is to lift a load of 50 kN through a height of 200 mm with a ground clearance of 300 mm. The available bearing pressure between nut and screw is 16 N/mm². The coefficient of thread and collar friction may be taken as 0.14. Design the screw jack.</p> |