

12167

21112

4 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All Questions are *compulsory*.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.
(6) Use of Non-programmable Electronic Pocket Calculator is permissible.
(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

- | | Marks |
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| 1. (A) Attempt any THREE of the following : | 12 |
| (a) What are Preferred numbers ? How are they useful ? How are the series of preferred numbers designated ? | |
| (b) Define creep. Draw and label creep curve. Describe effect on creep rate. How is it reduced ? | |
| (c) Define the terms Ergonomics and Aesthetics. List four ergonomic considerations that make the job comfortable. | |
| (d) Define factor of safety. What are the factors that are to be considered while selecting appropriate value of factor of safety ? | |
| (B) Attempt any ONE of the following : | 6 |
| (a) What is bolt of uniform strength ? Determine the size of the hole that must be drilled in M48 size ordinary bolt such that bolt becomes uniform strength. The core diameter of bolt is 41.795 mm. | |
| (b) Define ultimate stress & permissible stress. Determine the smallest size of punch that can be made to punch 10 mm thick mild steel plate having ultimate shear stress as 0.3 kN/mm^2 & permissible crushing stress for hardened punch is 1.3 kN/mm^2 . | |

P.T.O.

2. Attempt any FOUR of the following : 16

- (a) Draw a neat sketch of socket and spigot type cotter joint. Write proportions adopted in terms of rod diameter 'd' if joint is made up of steel.
- (b) Write use of turn buckle. Design only rod diameter for a turnbuckle to withstand a load of 1600 N. The permissible stresses in rod material are 70 N/mm^2 and 60 N/mm^2 in tension and shear respectively.
- (c) A shaft is transmitting 100 kW at 160 rpm. Find suitable diameter shaft, if the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress as 70 MPa.
- (d) Write strength equations of sunk key and prove that a square key is equally strong in shearing and crushing.
- (e) List type of couplings and write four requirements of a good coupling.

3. Attempt any FOUR of the following : 16

- (a) What are types of lever depending on load and effort applied. Write application of each.
- (b) Write design procedure for hand lever.
- (c) What is Nipping of leaf springs ? Why is it done ?
- (d) Write formula & explain terms used to design a shaft subjected to combined twisting and bending moments.
- (e) What assumptions are made while designing a joint ? What is the difference between joint and coupling related to their application ?

4. (A) Attempt any THREE of the following : 12

- (a) Design only fulcrum pin for a right angled bell crank lever. The horizontal arm is 500 mm long and a load of 4.5 kN acts vertically downward through a pin in the forked end of this arm. At end of 150 mm long arm which is perpendicular to the 500 mm long arm, a force 'P' act at a right angles to the axis of 150 mm arm through a pin in the forked end. The lever consists of forged steel material and a pin at the fulcrum. Take safe stress 75 MPa in tension, 60 MPa in shear, and safe bearing pressure on pins 10 N/mm^2
- (b) Design a fully floating rear axle if :
 - (i) Engine power = 80 kW at 5000 rpm.
 - (ii) Gear box reduction ratio = 4 : 1, 2.4 : 1, 1.5 : 1, and 1 : 1
 - (iii) Differential reduction = 5 : 1Fs for shaft material 65 N/mm^2 . Sketch arrangement of axle.

- (c) Write eight design considerations for friction clutch.
- (d) Design the skirt length of the piston with given data for petrol engine. Maximum pressure inside the cylinder = 4.5 N/mm^2 . Piston diameter = 70 mm. Side thrust is limited to 8% of the maximum load on the piston. Allowable bearing pressure = 0.3 N/mm^2 .

(B) Attempt any ONE of the following : **6**

- (a) Draw a neat sketch of knuckle joint. Design a knuckle joint to transmit a pull of 150 kN. The ultimate strength of material used is 300 MPa in tension, 240 MPa in shear and 600 MPa in crushing. Take factor of safety equal to 4.
- (b) Design and make a neat proportionate sketch of muff coupling for a shaft which transmits 37.5 kW at 240 rpm. The allowable stresses for shaft and key are 60 N/mm^2 and 126 N/mm^2 in shearing & crushing respectively. The safe stress in cast iron muff is 10 N/mm^2 .

5. Attempt any TWO of the following : **16**

- (a) (i) Draw a neat sketch of four speed sliding mesh gear box showing location of bearing on it. **(3)**
- (ii) A four speed gear box is to be constructed for providing ratios of 1.0, 1.46, 2.28 and 3.93 as to 1 as nearly as possible. The diametral pitch of each gear is 3.25 mm and smallest pinion is to have at least 15 teeth. Determine suitable teeth on different gears. What is then distance between main and layout shaft. **(5)**
- (b) (i) Define the term spring rate and spring index related to compression spring. **(3)**
- (ii) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm . If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2 , find the axial load which spring can carry and deflection per active turn considering the effect of curvature. **(5)**
- (c) (i) Draw a neat sketch showing thrust and non-thrust sides of piston. **(3)**
- (ii) Design the connecting rod cross-section with following data for petrol engine. Maximum pressure inside the cylinder = 4.5 N/mm^2 , Piston diameter = 70 mm, Stroke length = 80 mm, effective length of connecting rod = 140 mm, Ultimate crushing stress in rod material = 300 N/mm^2 , Factor of safety = 3, Take Rankine Constant for steel = $1/1600$ **(5)**

6. Attempt any TWO of the following :**16**

(a) Draw a neat sketch of overhead valve mechanism. Mention the material used for various components of mechanism. Design the port dimensions to lift for exhaust valve with following data.

(i) diameter of piston = 70 mm

(ii) stroke length = 80 mm

Exhaust velocity of gases is 120 m/s with 5000 rpm gases enters at 45°.

(b) Describe the procedure to design an overhung crankshaft of an I.C. Engine.

(c) Define :

(i) Indicated power

(ii) Brake power

Calculate stroke length of four stroke engine with following specification :

B.P = 4.5 kW, Speed = 1200 rpm,

Mean effective pressure (indicated) = 0.35 N/mm² and mechanical efficiency = 80%
