

ME (11)

6E7011

Roll No. _____

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6E7011

B.Tech. VI Semester (Main/Back) Examination, April/May - 2017
Mech. Engg.
6ME1A Design of m/c Element II
AE, ME, PI

Time : 3 Hours

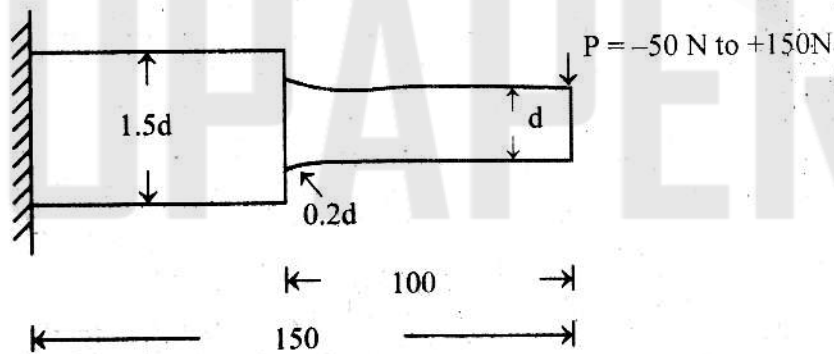
Maximum Marks : 80
Min. Passing Marks : 26

Instructions to Candidates:

Attempt any **five questions**, selecting **one question from each unit**. All questions carry **equal marks**. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitable be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

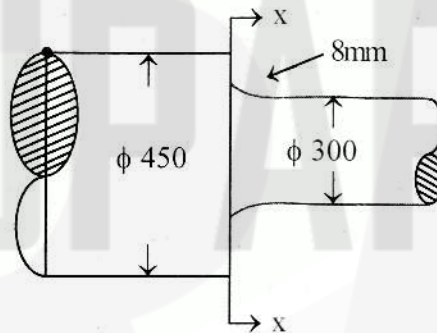
Unit-I

1. a) Explain modified goodman diagram for bending stresses. (6)
- b) A cantilever beam made of cord drawn steel 40C8 ($S_{ut} = 600\text{N/mm}^2$ and $S_{yt} = 380\text{ N/mm}^2$) as shown in fig. The force P acting at the free end varies from -50N to $+150\text{N}$. The expected Reliability is 90% and factor of safety is 2. Notch sensitivity at fillet is 0.9. Determine diameter of beam at the fillet cross section. (10)



(OR)

1. a) What is endurance strength? Draw S-N diagram, What are the factors that affect endurance strength. (8)
- b) The section of a steel shaft is shown in fig



The shaft is machined by a turning process. The section x-x is subjected to a constant bending moment of 500kN-m, the shaft material has $S_{ut} = 500\text{MN/m}^2$ & $S_{yt} = 350\text{MN/m}^2$ and endurance limit in bending for 7.5mm diameter specimen of 210 MN/m². Notch sensitivity is 0.8. Expected reliability is 90%. Determine life of shaft. Theoretical stress concentration factor can be taken from tabulated values. (8)

r/d	0.025	0.05	0.1
k_t	2.6	2.05	1.66

Unit-II

2. a) Explain Buckling of connecting rod. also prove for connecting rod cross section that $3.2 I_{yy} = I_{xx}$. (6)
- b) Design a connecting rod for a high speed I.C engine using following data.

Cylinder bore = 125mm, length of connecting rod = 300mm

Max. gas pressure = 3.5 MPa, length of stroke = 125mm

Mass of reciprocating parts = 1.6kg, engine speed = 2200 rpm

Assume suitable data and state the assumptions you made.

(10)

(OR)

2. a) The cylinder of a four stroke diesel engine has the following specification :

Brake power 7.5 kW, Speed = 1400rpm, Indicated mean eff. pr. = 0.35MPa
 $\eta_{\text{mech}} = 80\%$, Max. gas pr. = 3.5 MPa. The cylinder liner and head are made
of grey cast Iron FG 260 ($S_{\text{ut}} = 260\text{N/mm}^2$ and $\mu = 0.25$) the studs are made
of plain carbon steel 40C8 ($S_{\text{yt}} = 380\text{N/mm}^2$). Factor of safety for all parts is
6. Calculate :

(8)

- i) Bore and length of cylinder liner
- ii) Thickness of cylinder liner
- iii) Thickness of cylinder head
- iv) Size, number and pitch of studs

b) Design a cast iron piston for a single acting four stroke diesel engine with the following data.

Cylinder bore = 300mm, length of stroke = 450mm, speed = 300rpm.

IMEP = 0.85MPa, Max. gas pr. = 5MPa, fuel consumption = 0.3kg/BP/hr.

Higher calorific value of fuel = 44000 kJ/kg.

Assume suitable data and state the assumptions.

(8)

Unit-III

3. a) Explain spring design against fluctuating load also draw fatigue diagram for spring.

(6)

[Contd....

(3)

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- b) A railway wagon moving at a velocity of 1.5m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of wagon is 1500kg. The springs are compressed by 150mm is bringing the Wagon to rest. The spring index can be taken as 6. The springs are made of oil hardened and tempered Steel wire with $S_{ut} = 1250 \text{ N/mm}^2$ and modulus of rigidity = 81370 N/mm^2 . The permissible shear stress for spring wire can be taken as 50% of S_{ut} . Design spring and calculate. (10)

- i) Wire diameter
- ii) Mean coil diameter
- iii) Number of active coils
- iv) Total number of coils
- v) Solid length
- vi) Free length
- vii) Pitch of coil
- viii) Required spring rate
- ix) Actual spring rate

(OR)

3. a) Prove that for Belt drive - (8)

$$\frac{P_1 - mv^2}{P_2 - mv^2} = e^{\mu\theta}$$

Where P_1 and P_2 are tension in tight and slack side

$\mu \rightarrow$ coefficient of friction

$\theta \rightarrow$ Angle of lap

$m \rightarrow$ mass per meter of belt

- b) It is required to design a V-Belt drive to connect a 7.5kW, 1440 rpm induction motor to a fan, running at approximately 480rpm, for a service of 24h/day. Space available for a center distance is about 1m. (8)

Unit-IV

4. a) Derive lewis equation for Beam strength of gear. (6)
- b) It is required to design a pair of spur gear with 20° full depth involute teeth consisting of 20 teeth pinion meshing with 50 tooth gear. The pinion shaft is connected to a 22.5kW, 1450rpm electric motor. The starting torque of motor can be taken as 150% of rated torque. The material for pinion is plain carbon steel Fe410 ($S_{ut} = 410\text{N/mm}^2$). While gear made of grey cast iron FG200 ($S_{ut} = 200\text{N/mm}^2$). Factor of safety = 1.5, design of gear based on Lewis equation & using velocity factor to account for dynamic load. (10)

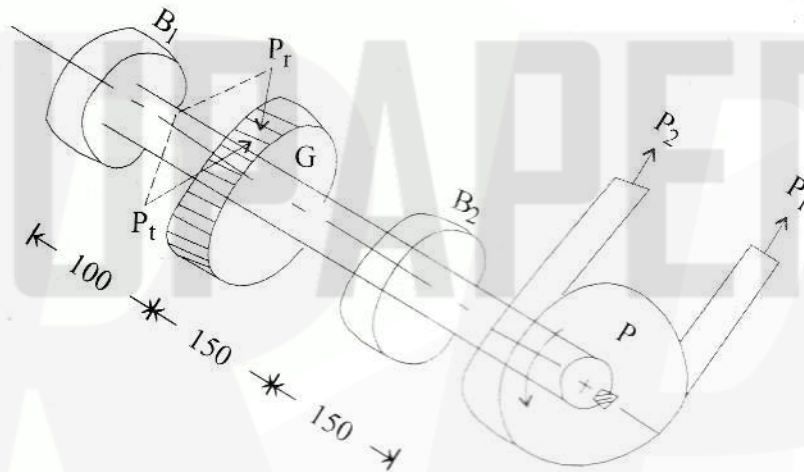
(OR)

4. a) Explain following : (8)
- i) Herring bone-gear
- ii) Wear strength of helical gear
- b) A pair of parallel helical gears consisting of a 20teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720rpm. The normal pr. angle is 20° . While helix angle is 25° . The face width is 40mm and the normal module is 4mm. The pinion as well as gear made of 40C8 ($S_{ut} = 600\text{N/mm}^2$). and heat treated to surface hardness of 300BHN. The service factor and factor of safety are 1.5 and 2 respectively. Assume velocity factor account for dynamic load and calculate power transmitting capacity of gears. (8)

Unit-V

5. a) Write short note on Mounting of Bearings. (6)

- b) A transmission shaft rotating at 720rpm and transmitting power from the pulley p to the spur gear G as shown in fig. the Belt tensions and gear tooth forces are as follows $P_1 = 498\text{N}$, $P_2 = 166\text{N}$, $P_t = 497\text{N}$, $P_r = 181\text{N}$. The weight of the pulley is 100N. The diameter of shaft at Bearing B_1 & B_2 is 10mm & 20mm respectively. The load factor is 2.5 and the expected life for 90% of Bearing is 8000 hrs. Select single row deep groove ball bearings at B_1 & B_2 . (10)



(OR)

5. a) Derive Petroff's equation for sliding contact Bearings. (8)
 b) The following data is given for a 360° Hydrodynamic bearings.

radial load = 10kN

Viscosity of Lub. = 30 mPa-s

Journal speed = 1440 rpm

Unit Bearing pr. = 1000 kPa

Clearance ratio (r/c) = 800

Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing calculate - (8)

- i) Dimensions of bearings

- ii) Coeff. of friction
- iii) Power lost in friction
- iv) Total oil flow
- v) Side leakage and
- vi) Temperature rise

