Subject: **AUTOMOBILE ENGINE COMPONENT DESIGN**   Date: **11/11/2016**
Subject Code: **AE (502)**   Time: **10:30a.m. – 1:30 p.m.**
   Total Marks: **70**

**Instructions:**
1. Answer each section in separate Answer sheet.
2. Use of Scientific calculator is permitted.
3. All questions are **Compulsory**.
4. Indicate **clearly**, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of **rough work**.

## SECTION-I

Q:1 (A) What is the Stress Concentration? What are the various causes of Stress Concentration? Discuss the various methods of reducing the effect of stress Concentration. **[5]**

 (B) Give the difference between following terms Regarding Limit Fits and tolerance. **[5]**

  (i)   Basic Size and nominal Size
  (ii)   Allowance and Tolerance
  (iii)   Unilateral and Bilateral Tolerance
  (iv)   Mean and Fundamental Deviation

 (C) What is Derived Series? Explain about different Derived Series and its use with example. **[5]**

**OR**

 (C) A manufacturer is interested in starting a business with five different models of Tractors ranging from 7.5 KW to 75 KW capacities. Specify power capacities of models. There is an expansion plan to further increase number of models from five to nine to fulfil the requirement of farmers. Specify the power capacities of the additional models. **[5]**

Q:2 (A) What is the difference between Endurance strength and Endurance limit? Explain it. **[4]**

 (B) A cantilever beam of circular cross section is fixed at one end and subjected to completely reversed force of 10 KN at the free end. The force is perpendicular to the axis of the beam. The distance between Free and fixed ends is 100 mm. The beam is made of steel with ultimate tensile strength of 540 N/mm$^2$ and tensile yield strength of 320 N/mm$^2$. The construction of the cantilever is such that there is no stress concentration. The size factor, surface finish factor and reliability factor are 0.85, 0.8 and 0.868 respectively. The operating temperature is 50° C for which the temperature factor is 1.010. If the diameter of the beam is 35 mm, Determine the Life of the Beam. **[6]**

**OR**

Q:2 (A) How will you find the endurance limit of the material? **[5]**

**(B)** A plate made of plain carbon steel 20C8 (Sut = 440 N/mm$^2$ is shown in Figure 1. The theoretical stress concentration factor and notch sensitivity are 2.50 and 0.80 respectively. The surface finish factor, size factor and reliability factor are 0.67, 0.85 and 0.897 respectively. The plate thickness is 30 mm. If the required factor of safety is 2.0, Determine the maximum completely reversed axial force the plate can take for Infinite Life. **[5]**

**Q:3 (A)** State and explain the factors to be considered while selecting the types of gear drive for the given application. **[5]**

**(B)** With the help of neat sketch, explain the components of force acting on Spur gear tooth. **[5]**

**OR**

**Q:3 (A)** What do you meant by Fits? Explain different types of Fit. **[5]**

**(B)** What do you mean by Fluctuating stress? Explain about Repeated Stress and Completely Reversed Stress. **[5]**

## SECTION-II

**Q:4 (A)** The Cylinder of four stroke diesel engine has the following specifications: **[4]**
Brake Power = 3.75 KW
Speed = 1000 rpm
Indicated mean effective pressure = 0.35 MPa
Mechanical Efficiency = 80 %
Determine the bore and length of the cylinder liner.

**(B)** The following data is given for the Piston of a Four stroke diesel engine: **[6]**
Cylinder bore = 250 mm
Maximum gas pressure = 4 MPa
Bearing pressure at small end of connecting rod = 15 MPa
Length of Piston pin in bush of small end = 0.45 D
Ratio of inner to outer diameter of piston pin =0.6
Mean diameter of piston boss = 1.4 x outer diameter of piston pin
Allowable bending stress for piston pin = 84 N/mm$^2$
Calculate: (i) Outer diameter of the piston pin
(ii) Inner diameter of the piston pin
(iii) Mean diameter of the piston boss
(iv) Check the design for bending stresses.

**(C)** The following data is given for the Piston of a four stroke diesel engine: **[5]**
Cylinder bore = 250 mm
Material of piston rings = Grey cast iron
Allowable tensile stress = 100 N/mm2
Allowable radial pressure on cylinder wall = 0.03 MPa
Thickness of Piston Head = 42 mm
Number of piston rings = 4

2/3

Calculate:

(i)     Radial width of piston rings       (ii)    Axial thickness of the piston rings
(iii)    Gap between the free ends of the piston ring before assembly
(iv)    Gap between the free ends of the piston ring after assembly
(v)     Width of top land              (vi)   Width of the ring grooves
(vii)    Thickness of the piston barrel     (viii) Thickness of the barrel at open end.

**OR**

(C)   What are the advantages and disadvantages of aluminium piston over cast iron piston?   [5]

Q:5   (A)   The load on the Journal Bearing is 150 KN due to turbine shaft of 300 mm diameter   [4]
running at 1800 rpm. Determine the following:

(i)      Length of the bearing if the allowable baring pressure is 1.6 N/mm$^2$, and
(ii)     Amount of heat to be removed by the lubricant per minute if the bearing
temperature is 60°C is 0.02 Kg/m-s and the bearing clearance is 0.25 mm.

(B)   A Footstep Bearing supports a shaft of 150 mm diameter which is counter-bored at the   [6]
end with a hole diameter of 50 mm. If the bearing pressure is limited to 0.8 N/mm$^2$ and
the speed is 100 rpm. Assume coefficient of friction is 0.015
Find (i) The load to be supported (ii) The power lost in friction
      (iii) The heat generated    at the bearing.

**OR**

Q:5   (A)   A shaft rotating at constant speed is subjected to variable load. The bearings supporting   [6]
the shaft are subjected to stationary equivalent radial load of 3 KN for 10% of time,
2KN for 20 % of time, 1 KN for 30 % of time and no load for remaining time of cycle.
If the total life expected for the bearing is 20 x 10$^6$ revolutions at 95 % reliability,
calculate Dynamic load rating of the Ball bearing.

(B)   Explain the types of Rolling contact Bearing with neat sketches.   [4]

Q:6   (A)   Explain about different materials used for Engine Components.   [5]
(B)   Explain about different materials used for Bearing.   [5]

**OR**

Q:6   (A)   Derive an expression for Beam strength (Lewis Equations) of Spur Gear tooth.   [5]
(B)   Give Answer of following two questions.
(I)   Why Helical gears are preferred at higher speeds ?   [2]
(II)   Explain the following terms related to Helical Gear   [3]
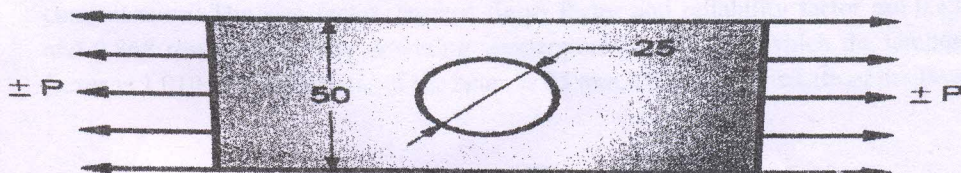     (a) Transverse Circular Pitch   (b) Normal Circular pitch   (c ) Axial Pitch



**Figure 1**

3/3

# KADI SARVA VISHWAVIDYALAYA

## B.E SEMESTER V Theory EXAMINATION (November / 2015)

SUBJECT CODE: AE 502  SUBJECT NAME: Automobile Engine Component Design

DATE: 21/11/2015  TIME: 10.30 p.m. To 1.30 p.m.  TOTAL MARKS: 70

Instructions:
1. Answer each section in separate Answer Sheet.
2. Use of scientific Calculator is permitted.
3. All questions are compulsory.
4. Indicate **clearly**, the options you attempted along with its respective question number.
5. Use the last page of main supplementary for rough work.

### Section - 1

Q:1 Answer the following Question. (All Compulsory)

(A) Explain design consideration for manufacturing (DFM).

(B) Define the stress concentration factor? List out the reason for stress concentration.

(C) A cantilever beam made of cold drawn steel 20C8 (Sut = 540 N/mm$^2$ ) is subjected to a completely reversed load of 1000 N as shown in fig. The notch sensitivity factor q at the fillet can be taken as 0.85 and expected reliability is 90 %. Determine the diameter of beam for life of 10000 cycles. Take surface finish factor 0.78, theoretical stress concentration factor 1.35 and size factor is 0.85.
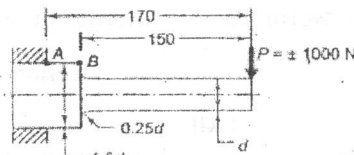


OR

(C)

A Cantilever spring made of 10 mm diameter wire is shown Fig . The wire is made of stainless steel (Sut = 860 N/mm2 and Syt = 690 N/mm2). The force p acting at free end varies from 75 to 150 N. The surface finish of the wire is equivalent to the machined surface. There is no stress concentration and expected reliability is 50 %. Calculate the number of stress cycle likely to cause fatigue failure. Take Ka = 0.72, Kb = 0.85.



Q:2 Answer the following Question.

(A) Explain notch sensitivity and endurance limit.

(B) A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4 : 1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively.
The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength.

(A) Explain the law of gearing.                                                                05

(B) A helical cast steel gear with 30° helix angle has to transmit 35 kW at 1500 r.p.m. If the gear has   05
24 teeth, determine the necessary module, pitch diameter and face width for 20° full depth teeth.
The static stress for cast steel may be taken as 56 MPa. The width of face may be taken as 3
times the normal pitch. What would be the end thrust on the gear? The tooth factor for 20° full
depth involute gear may be taken as $0.154 - \frac{0.912}{TE}$ where TE represents the equivalent number of
teeth.

Q:3   Answer the following Question.

(A) Derive the formula for Lewis equation in spur gear.                                         05

(B) A pair of cast iron bevel gears connect two shafts at right angles. The pitch diameters of the   05
pinion and gear are 80 mm and 100 mm respectively. The tooth profiles of the gears are of
14 1/2° composite form. The allowable static stress for both the gears is 55 MPa. If the pinion
Transmits 2.75 kW at 1100 r.p.m., find the module and number of teeth on each gear from the
standpoint of strength and check the design from the standpoint of wear. Take surface endurance
limit as 630 MPa and modulus of elasticity for cast iron as 84 kN/mm$^2$.

(A) Explain modified goodman diagram.                                                          05

(B) A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m. The worm   05
triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The
tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth
may be taken as 0.10. Calculate: 1. tangential force acting on the worm; 2. axial thrust and
separating force on worm; and 3. efficiency of the worm drive.

**Section - 2**

Q:4   Answer the following Question.  (All Compulsory)

(A) What are the methods and materials used in the manufacture of IC engine components?        05

(B) A four stroke diesel engine has the following specifications :                             05
Brake power = 5 kW ; Speed = 1200 r.p.m. ; Indicated mean effective pressure = 0.35 N / mm$^2$ ;
Mechanical efficiency = 80 %.constant C=0.1, tensile stress for cylinder wall= 42 Mpa, tensile
stress for stud= 65 Mpa. Determine: 1. Bore and length of the cylinder; 2. Thickness of the
cylinder head; and 3. Size of studs for the cylinder head.

(C) Explain the various types of cylinder liners.                                              05

(C) Sketch a valve gear mechanism of an internal combustion engine and label its various parts   05

Q:5   Answer the following Question.

(A) Design a cast iron piston head, piston ring, piston barrel, piston skirt for a single acting four   0
stroke engine for the following data:
Cylinder bore = 100 mm; Stroke = 125 mm; Maximum gas pressure = 5 N/mm$^2$; Indicated mean
effective pressure = 0.75 N/mm$^2$; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per
brake power per hour; Higher calorific value of fuel = 42 × 103 kJ/kg; Speed = 2000 r.p.m. stress
for head=38 Mpa, heat constant C=0.05, For cast iron , k = 46.6 W/m/°C, and $T_C - T_F$ = 220°C),
coefficient of friction u=0.1, bearing pressure $P_b$ = 0.45 N/mm$^2$ Any other data required for the
design may be assumed.

(B) Why the area of the inlet valve port is made larger than the area of exhaust valve port?    0

(A) Determine the dimensions of I cross section of the connecting rod for the diesel engine with given data. Cylinder bore=100 mm, length of connecting rod = 320 mm. Maximum gas pressure= 2.45 MPa, factor of safety =5.

(B) Write down design steps of piston pin.

Q:6 Answer the following Question.

(A) Write down Types of Sliding Contact Bearings with neat sketch.

(B) The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 r.p.m. Determine 1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm$^2$, and 2. Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm and k= 0.002.

OR

(A) Write down advantages and disadvantages of rolling contact bearings over sliding contact bearings.

(B) Determine dynamic load rating of a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load with the radial load factor (X) =0.56 and axial load factor (Y) = 1.

-----All the Best --------

3/3