HNS

100126

2008

# MECHANICAL ENGINEERING (Optional)

## यंत्र अभियांत्रिकी ( वैकल्पिक )

**Time : 3 hours** **Maximum Marks : 200**

**Note :**

*(i)* *In all attempt Five questions.*

*(ii)* *Question number 1 is compulsory.*

*(iii)* *Of the remaining questions, attempt Any four by selecting one Question from each section.*

*(iv)* *Numbers of optional questions upto the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the questions will not be assessed.*

*(v)* *Candidate should not write roll number, any names (including his/her own), signature, address or any indication of his/her identity anywhere inside the answer book otherwise he/she will be penalised.*

**1.** Answer *any four* of the following (*10 marks each*) **40**

(a) List any 5 important properties of metallic materials giving their practical applications.

(b) Describe in brief the basic components of a " Numerically Controlled Machine Tool."

(c) Draw a neat sketch of Layout of "Hydroelectric Power Plant " showing various safety devices used on it.

(d) Draw and explain typical "Heat Balance Sheet" of a Boiler.

Also define the terms.

(i) Equivalent Evaporation.

(ii) Economiser Efficiency.

(e) In an air-conditioned conference room of size 20m × 12m × 3m, fifty persons are present. There is a temporary failure of its air-conditioning system. Each person gives up 400 kJ of heat per hour. The room is completely insulated. Assume that each person occupies a volume of $0.07m^3$.

Determine the increase in temperature of air inside the room after 10 minutes . Given room temperature is 20°C and air pressure is 1 bar.

**P.T.O.**

## SECTION-A

**2.** Answer the following sub-questions :

(a) Classify different types of Gear Trains and explain in brief "Compounded Gear Train". How would you calculate its "velocity ratio" ? **15**

(b) Design a Helical Spring for a spring loaded Ramsbottom Safety valve for following data: **15**

(i) Diameter of seat = 100 mm

(ii) Operating pressure = 1 $N/mm^2$

(iii) Maximum pressure when the valve blows off freely = 1.075 $N/mm^2$

(iv) Maximum allowable stress = 400$N/mm^2$

(v) Modulus of Rigidity = $84x10^3$ $N/mm^2$

(vi) Spring Index = 5.5

(c) Specify three different principal classification of "Geometric Modelling Systems" and write in brief about each of them. **10**

**3.** Answer the following sub-questions :

(a) A vertical shaft of 5mm diameter and 200mm long is supported in bearings at its ends. A disc of mass 50 kg is attached to the centre of this shaft. Find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. **15**

Given E = 200 $GN/m^2$

(b) Draw a neat sketch of Socket and Spigot Cotter Joint and explain various failures considered in designing this joint. Sketch section areas under failure. **15**

(c) Explain with neat diagrams the functions served by "pre-processor" and "post-processor" in the Finite Element Analysis. **10**

## SECTION-B

**4.** Answer the following sub-questions :

(a) Sketch and describe a Hydraulic Circuit for Shaper Machine. What are the advantages and disadvantages of Hydraulically actuated machine tools. **20**

(b) Write explanatory notes on : **20**

(i) ABC Analysis

(ii) EOQ Model

used in Production Planning and Control

**5.** Answer the following sub-questions :

(a) What are the qualities of flame used in Gas welding ? Distinguish between types of welding flames giving their applications. **20**

(b) A small Engineering project consists of six activities namely, A, B, C, D, E and F with duration of 4, 6, 5, 4, 3 and 3 days respectively. Draw the network diagram and calculate EST, LST, EFT, LFT and floats. Also mark the critical path and find out total project duration. **20**

## SECTION-C

**6.** Answer the following sub-questions :

(a) What are the conditions of equilibrium of a "floating body" and a "submerged body"? Explain with neat sketches. **15**

(b) A masonry dam 8m high, 1.5m wide at the top and 5m wide at the base retains water 7.5 m deep, the water face of dam being vertical. Find the maximum and minimum stress intensities at the base. The weight of water is 9810 $N/m^3$ while the weight of masonry is 22 $kN/m^3$. Assume one meter run of the dam. **15**

(c) Describe with one example : Buckingham's $\pi$ theorem and its use for model analysis. **10**

9. Answer the following sub-questions :

(a) What is the necessity of providing lubrication systems on I.C. Engines ? Describe with neat sketch : Pressurised Lubrication system. **15**

(b) Derive the expression for volumetric efficiency of single stage Reciprocating Air Compressor (with clearance). What is the effect of increasing clearance on this efficiency ? **10**

(c) A thin walled concentric tube heat exchanger is used to cool engine oil form 160°C to 60°C with the help of water as coolant entering at 25°C. Their flow rates are 2 kg/sec each. The diameter of inner tube is 0.5 m and the overall heat transfer coefficient is 250 $W/m^2$. What must be the length of heat exchanger to accomplish the desired cooling ? **15**

(Cp) water = 4.187 kJ/kg.K

(Cp) oil = 2.035 kJ/kg.K

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7. Answer the following sub-questions :

(a) Explain how the metacentric height of floating body is determined theorotically and experimentally. **15**

(b) Find the discharge of water flowing through a pipe 300 mm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 150 mm. The pressure difference between the main and the throat is measured by a liquid ( specific gravity 0.6) equals 300 mm. The loss of head between main and throat is 0.2 times the kinetic head of the liquid in pipe. **15**

(c) Describe with one example : Applications of Dimensional Analysis for model testing. **10**

## SECTION-D

8. Answer the following sub-questions :

(a) Describe with neat sketch "Electronic Ignition System" used on I.C. Engines. What are its advantages over conventional Ignition Systems. **15**

(b) A multistage Reciprocating Air compressor receives air at 1 bar and 38°C. The delivery pressure at the end of last stage is 100 bar. Assuming perfect intercooling between all stages and the law of compression as polytropic (n = 1.3), determine the number of stages the compressor must use if maximum discharge temperature from any stage is not to exceed 140°C. **10**

(c) Draw layout of a typical "Psychrometric Chart" and show following processes on it. **15**

(i) Sensible cooling and Sensible heating.

(ii) Cooling with dehumidification.

(iii) Cooling with adiabatic humidification.

(iv) Heating and humidification.

**P.T.O.**