

2008

MECHANICAL ENGINEERING

Paper 1

*Time : 3 Hours]**[Maximum Marks : 300*

INSTRUCTIONS

*Candidates should attempt **all** the questions in Parts A, B & C. However, they have to choose only **three** questions in Part D.*

Answers must be written in the medium opted (i.e. English or Kannada).

This paper has four parts :

A	20 marks
B	100 marks
C	90 marks
D	90 marks

Marks allotted to each question are indicated in each part.

SEAL

PART A

4×5=20

Answer each question in about 50 words. Each question carries 5 marks.

1. (a) What do you understand by gyroscopic couple ? Derive a formula for its magnitude. 5
- (b) Sketch an intermittent motion mechanism and explain its practical application. 5
- (c) What is a chipless machining ? Give examples. 5
- (d) Differentiate between production and productivity. What is its relationship ? 5

PART B

10×10=100

Answer each question in about 100 words. Each question carries 10 marks.

2. (a) Explain the principle of virtual work as applied to a system in equilibrium. 5
- (b) Using the principle of virtual work, determine the reaction of a beam AB of span 8 m. The beam carries a point load 4 kN at a distance 3 m from A. 5
3. Explain with sketch the different types of cams and followers. 10
4. Explain the term whirling speed of a shaft. Prove that the whirling speed for a rotating shaft is the same as the frequency of natural transverse vibration. 10
5. (a) List the important factors that influence the magnitude of factor of safety. 5
- (b) Derive an expression for the impact stress induced due to a falling load. 5
6. (a) Draw Mohr's circle diagram for two dimensional state of stress. Show stresses involved. 6
- (b) Differentiate between hot working and cold working. 4
7. (a) What are the advantages and disadvantages of cast making tool frames ? 5
- (b) Draw neat sketch of a steady state rest used in lathe. 5
8. (a) Explain the difference between punching and blanking. 5
- (b) List the properties of material that influence spring back. Explain why they do. 5

[Turn over

9. List ten principles of value analysis. 10
10. Explain the working principle of explosive forming with neat sketch of schematic arrangement. 10
11. (a) What is acceptance sampling ? Why was it developed ? 5
- (b) What are the factors considered in designing a work station ? 5

PART C

6×15=90

Answer each question in about 150 words. Each question carries 15 marks.

12. Four masses m_1 , m_2 , m_3 and m_4 which are 200 kg, 300 kg, 240 kg and 269 kg respectively rotate in a plane. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and angle between successive masses are 45° , 75° and 135° . Find the position and magnitude of balance mass required, if its radius of rotation is 0.2 m. 15
13. A machine part of mass 2 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 25 N results in a resonant amplitude of 12.5 mm with a period of 0.2 seconds. If the system is excited by a harmonic force of frequency 4 Hz, what will be the percentage increase in the amplitude of vibration when damper is removed as compared with that of with damping ? 15
14. An MS rod 2.5 cm diameter and 2.2 m long is subjected to a gradually increasing compression load. Determine the buckling load. Find also the maximum lateral deflection corresponding to the buckling load. Both ends of the rod are pinned.
Take $E = 2 \times 10^4 \text{ kN/cm}^2$ and yield stress = 25 kN/cm². 15
15. Explain how the EDM process is capable of producing complex shapes. What is the difference between photochemical blanking and chemical blanking ? 15
16. Suppose a company manufacturing electronic calculators produced 10,000 calculators by employing 50 people at 8 hours/day for 25 days. What is the production and productivity ? The company increased its production to 12,000 calculators by hiring 10 additional workers at 8 hours/day for 25 days. What is the production and productivity now ? 15
17. What is the ABC analysis of an inventory control ? Explain. 15

[Turn over]

PART D

3×30=90

Answer any **three** of the following questions, each in about 300 words.
Each question carries 30 marks.

18. Design a rubber belt to drive a dynamo generator 20 kW at 2250 r.p.m. and fitted with a pulley 200 mm diameter. Assume dynamo efficiency to be 85%, allowable stress for belt is 2.1 MPa, density of the rubber is 1000 kg/m³, angle of contact for dynamo pulley is 165°, coefficient of friction between belt and pulley is 0.3. 30
19. A central steel rod 18 mm diameter passes through a copper tube 24 mm inside diameter and 40 mm outside diameter. Steel rod provides with nut and washer at each end and they are tightened on either side of the copper tube until a stress of 10 MPa is set up in the steel rod. The whole assembly is then placed on lathe and turned along half the length of the copper tube removing to a depth of 1.5 mm. Calculate the stress now existing in the steel rod. Take $E_{\text{steel}} = 2 E_{\text{copper}}$. 30
20. A porter governor has equal arms each 250 mm long and pivots on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum and maximum speed and range of speed of the governor. 30
21. What types of chips would be produced during machining of various materials and machining grey cast iron? Explain. Why are tool temperatures low at low cutting speeds and high at higher cutting speeds? 30
22. What are the technological based productivity improvement techniques? Explain. 30

SEAL

2008
MECHANICAL ENGINEERING
Paper 2

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[Maximum Marks : 300

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Kannada).*

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A	20 marks
B	100 marks
C	90 marks
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Marks allotted to each question are indicated in each part.

SEAL

PART A

4×5=20

Answer each question in about 50 words. Each question carries 5 marks.

1. (a) State Zeroth and First law of Thermodynamics. 5
- (b) Differentiate between static and dynamic pressure. 5
- (c) Explain different modes of heat transfer. Write one dimensional equation for each mode. 5
- (d) Explain two types of air standard cycles used in IC engine. 5

PART B

10×10=100

Answer each question in about 100 words. Each question carries 10 marks.

2. Define the terms internal energy and enthalpy. Differentiate between an engine, a refrigerator and a heat pump. 10
3. Differentiate between steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow and compressible and incompressible flow. 10
4. One meter long nichrome wire of resistance $1 \mu\Omega$ is to dissipate power of 10 kW in the surrounding fluid which is at 80°C . Find the diameter of the wire if the maximum operating temperature of the wire is 100°C . 10
5. With sketch explain the lubricating system used in an IC engine. 10
6. With schematic diagram explain the working of a vapour compression refrigeration system. 10
7. Explain the binary system of power plant used in nuclear power plant. 10
8. Differentiate between parallel, counter and cross flow heat exchangers. 10
9. Sketch and explain the working of a locomotive boiler. 10
10. Water vapour of 5 grams per kg of atmosphere air is removed and the temperature of air after removing the water vapour becomes 25°C DBT. Find (i) Relative humidity (ii) Dew point temperature. Assume condition of atmospheric air is 35°C and 60% RH at pressure of 1.03 bar. From psychrometric chart for air at 35°C DBT and 60% RH, $P_{\text{vapour}}, P_v = 0.05723$. 10
11. Draw a neat sketch of centrifugal pump and explain its parts. 10

PART C

6×15=90

Answer each question in about 150 words. Each question carries 15 marks.

12. A vessel of 0.4 m^3 capacity contains 2 kg of wet steam at 6 bar pressure. Calculate the volume and mass of water and volume and mass of dry steam. From steam table, specific volume of water, $v_f = 0.0011$ and saturated steam, $v_g = 0.3155$. 15
13. At a suddenly enlarged water main from 240 mm to 480 mm diameter pipe, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. 15
14. Aluminium fins of rectangular profile are attached on C plane wall with 5 mm spacing. The fins have thickness, $y = 1 \text{ mm}$, length, $l = 10 \text{ m}$ and the thermal conductivity, $k = 200 \text{ W/m K}$. The wall is maintained at a temperature of 200° C and the fins dissipate heat by convection into the ambient air at 40° C , with heat transfer coefficient $h = 50 \text{ W/m}^2 \text{ K}$. Determine the heat losses. 15
15. Draw a neat sketch of a simple carburettor and explain how it works. 15
16. An oil of specific gravity 0.88 and viscosity 3.8 poise flows in a 5 cm diameter pipe at a rate of 4 litres/sec. Comment whether the flow is laminar or turbulent. 15
17. Sketch and explain a summer air conditioning plant layout identifying each component. 15

PART D

3×30=90

Answer any **three** of the following questions, each in about 300 words.
Each question carries 30 marks.

18. A non-uniform part of a pipeline 5 m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2 . If the diameter at upper and lower end are 15 cm and 10 cm respectively, determine the quantity of water flowing per second. 30
19. The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process the pressure is 1.0 bar and temperature is 300 K. The heat transfer to the air per cycle is 1900 kJ/kg of air. Calculate
- the pressure and temperature at the end of each process of the cycle
 - thermal efficiency
 - the mean effective pressure 30
20. A three stage compressor is used to compress H_2 from 1.04 bar to 35 bar. The compression in all stages follows $pv^{1.25} = C$. The temperature of air at the inlet of compressor is 288 K. Neglecting the clearance and assuming perfect inter cooling, find out the indicated power required in kW to deliver 14 m^3 of H_2 per minute measured at inlet condition and also determine intermittent pressures. Take $R = 4.125 \text{ kJ/kg K}$. 30
21. How are water turbines classified ? A Pelton turbine has a bucket speed of 12 m/sec and is supplied with water at the rate of 750 litres/sec under a head of 35 m. If the bucket deflects the jet through an angle of 160° , find the power. The coefficient of velocity is 0.98. 30
22. What is the necessity for using solar energy ? With neat sketch explain the working of a power plant using solar energy as power source. 30