Total No. of Questions—12] [Total No. of Printed Pages—4+1

[3562]-111

S.E. (Mechanical) EXAMINATION, 2009

APPLIED THERMODYNAMICS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from each Section.
(*ii*) Answers to the two Sections should be written in separate answer-books.
(*iii*) Neat diagrams must be drawn wherever necessary.
(*iv*) Figures to the right indicate full marks.
(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
(*vi*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) What are the limitations of first law of thermodynamics ? [4]

(*b*) Write a note on PMM II. [4]

(*c*) Explain 'Principle of Increase of Entropy'. [4]

(*d*) Air expands irreversibly from 3 bar, 200°C to 1.5 bar, 105°C. Compute the entropy change per kg of air. [4]

Or

2. (*a*) Derive an expression for COP of refrigerator working on reversed Carnot cycle. [6]

(*b*) Give statements of second law of thermodynamics. [4]

(*c*) Air at 1 MPa and 250°C contained in a vessel having 0.28 m^3 volume is cooled until its pressure drops to 0.35 MPa. Determine change in entropy. [6]

P.T.O.

Unit II

3. (*a*) Derive equation of state of an ideal gas. [6]

(*b*) Compare Otto and Diesel cycle on the basis of same compression ratio and same heat rejection. [4]

(*c*) A mass of 0.25 kg of an ideal gas has a pressure of 300 kPa, temperature of 80°C and volume of 0.07 m^3. It undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.1 m^3 during which work done on the gas is 25 kJ. Evaluate C_P and C_V of the gas. [6]

Or

4. (*a*) Derive an expression for thermal efficiency of Sterling cycle. [6]

(*b*) What are the assumptions of air standard cycle analysis ? [4]

(*c*) An engine equipped with a cylinder having a bore of 15 cm and a stroke of 45 cm operates on an Otto cycle. If the clearance volume is 2000 cm^3, compute the air standard efficiency. [6]

Unit III

5. (*a*) What are the limitations of separating calorimeter and throttling calorimeter ? How are they overcome in a separating and throttling calorimeter ? [6]

(*b*) Define : [4]

(*i*) Specific steam consumption

(*ii*) Work ratio.

(*c*) A Rankine cycle operates between boiler pressure of 10 MPa and condenser pressure of 5 kPa. Determine the thermal efficiency, work ratio and specific steam consumption. [8]

Or

6. (*a*) Explain Carnot vapour power cycle with the help of T-S diagram. [6]

(*b*) Explain working of separating calorimeter with a neat sketch. [6]

(*c*) Find the entropy and enthalpy of steam when pressure is 2 MPa and the specific volume is 0.09 m^3/kg. [6]

SECTION II

Unit IV

7. (*a*) Derive an expression for volumetric efficiency of a reciprocating compressor. [6]

(*b*) Define : [4]

(*i*) Isothermal efficiency

(*ii*) Volumetric efficiency.

(*c*) A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm and is driving at a speed of 1200 rpm. It is compressing CO_2 from a pressure of 120 kPa and temperature of 25°C to a temperature of 215°C. Assuming polytropic compression index as 1.3, no clearance and 100% volumetric efficiency, calculate : [6]

(*i*) Pressure ratio

(*ii*) Indicated power and

(*iii*) Mass flow rate.

Take R = 0.189 kJ/kgK for CO_2.

Or

8. (*a*) Derive an expression for intermediate pressure for two stage compression with perfect intercooling. [6]

(*b*) Explain actual indicator diagram of a single stage reciprocating compressor. [4]

(*c*) Explain with a neat sketch, any one capacity control method used for reciprocating compressors. [6]

Unit V

9. (*a*) Explain Boys Gas calorimeter with a neat sketch. [8]

(*b*) Gasoline (C_8H_{18}) reacts with pure oxygen gas to form products that include only CO_2 and H_2O. Determine the mass of each product per kg of fuel supplied for the reaction. [8]

Or

10. (*a*) Define : [4]

HCV and LCV.

(*b*) Explain stoichiometric air-fuel ratio and excess air. [4]

(*c*) Diesel fuel ($C_{12}H_{26}$) reacts with 80% theoretical air. Determine the products of combustion on volume basis. [8]

Unit VI

11. (*a*) Write a note on 'Classification of Boilers'. [6]

(*b*) Define 'Equivalent evaporation form and at 100°C. [3]

(*c*) What is second law efficiency ? [3]

(*d*) 1 kg of air at 500 K is heated reversibly at constant pressure to 2000 K. Find the available energy and unavailable energy. [6]

Or

12. (*a*) Define :

(*i*) Available energy

(*ii*) Unavailable energy. [4]

(*b*) What is boiler draught ? [4]

(*c*) Write a note on 'Irreversibility'. [4]

(*d*) In an experiment on a small oil fired boiler, the steam produced is 6 bar guage. The quality of steam produced is found out to be 0.96. 75 litres of water is converted into steam in 9.5 minutes. The fuel is light diesel oil with specific gravity 0.85 and calorific value of 43125 kJ/kg. Ten litres oil is consumed in 11 minutes 25 seconds. The feed water temperature is 35°C. Determine the boiler efficiency. Take atmospheric pressure = 1 bar. [6]

Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

[3562]-112

S.E. (Mech.) EXAMINATION, 2009

STRENGTH OF MACHINE ELEMENTS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Define and explain the following terms : [8]

(*i*) Allowable stress

(*ii*) Thermal stress

(*iii*) Bulk modulus

(*iv*) Lateral strain.

P.T.O.

(*b*) A square bar 25 mm × 25 mm is subjected to axial forces at different locations as shown in Fig. 1.
Find total elongation of the bar, if E = 200 GPa. [6]

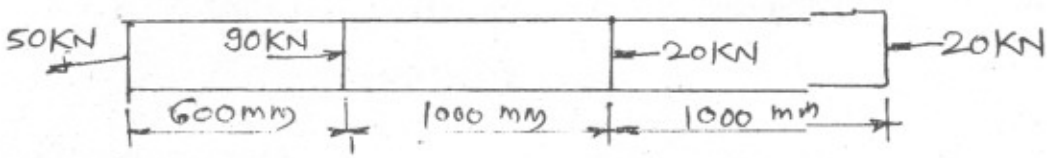


Fig. 1

(*c*) Draw and explain typical stress-strain diagram for ductile materials indicating all the salient points. [4]

Or

2. (*a*) A composite rod as shown in Fig. 2 is loaded by various axial forces. Determine the largest value of 'P' such that the stress in steel does not exceed 150 MPa and that in brass does not exceed 75 MPa. Hence determine elongation of the bar. Take E_{steel} = 200 GPa and E_{brass} = 75 GPa. [8]

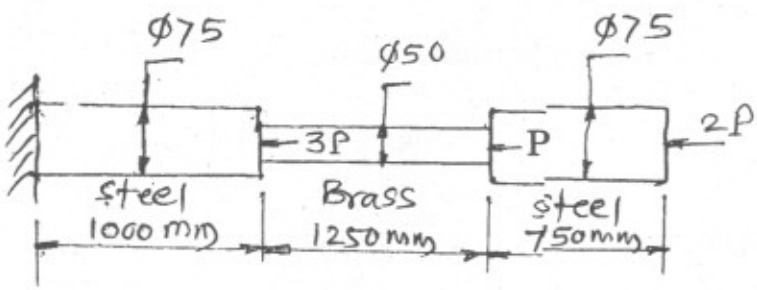


Fig. 2

(*b*) Derive an expression for volumetric strain in a bar of cross-section ($b \times t$) and length 'L', subjected to an axial tensile stress σ_L. [6]

(*c*) Explain the concept of thermal stress and strain. [4]

3. (*a*) Explain the significance of the following terms :

(*i*) Neutral axis

(*ii*) Moment of resistance

(*iii*) Section Modulus. [6]

(*b*) State any *four* assumptions in bending theory. [2]

(*c*) With usual notations, derive flexural formula : [8]

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}.$$

Or

4. (*a*) An I-section beam 340 mm × 200 mm has a web thickness 10 mm and flange thickness of 20 mm. It carries a shearing force of 100 kN. Sketch the shear stress distribution across the section. [8]

(*b*) A steel section shown in Fig. 3 is subjected to a shear force of 200 kN. Determine the shear stress at important points and sketch the shear stress distribution diagram. [8]

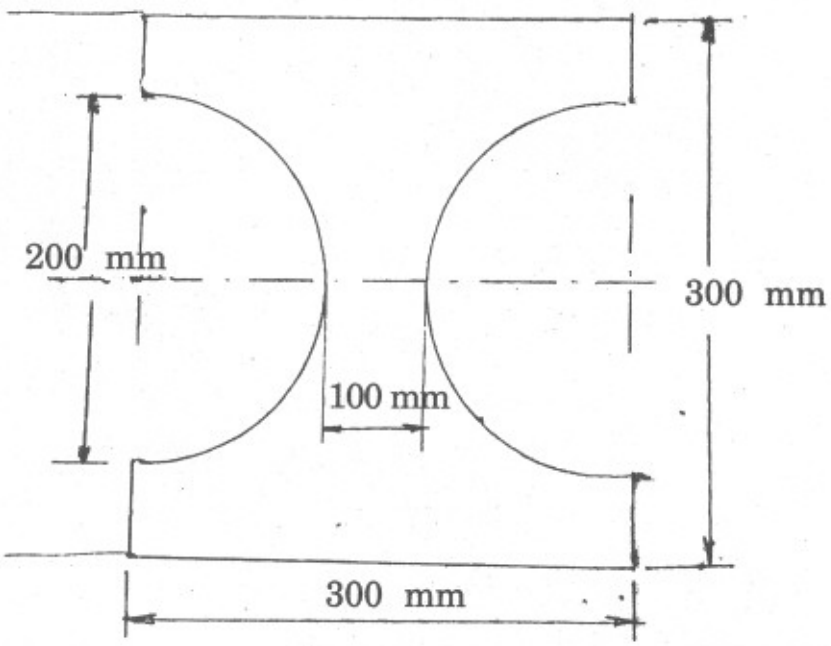


Fig. 3

5. (*a*) For beam AE loaded and supported as shown in Fig. 4, find slope and deflection at C and E. Take E = 200 kN/mm² and I = 2000 cm⁴. [12]

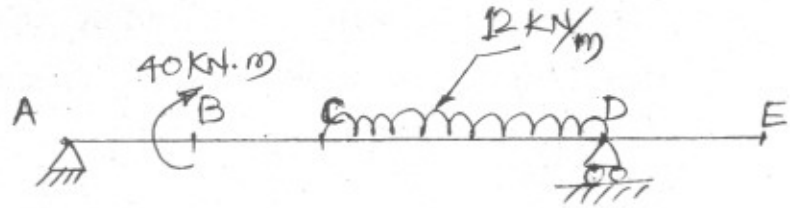


Fig. 4

(*b*) What do you mean by 'Conjugate Beam'. [2]

(*c*) Explain Mohr's theorems in brief as applied to 'Conjugate Beam Method'. [2]

Or

6. (*a*) Determine slope and deflection at B, C and D of a cantilever AD as shown in Fig. 5. Use 'Mement-Area Method'. Take EI = 10 × 10⁴ kN.m². [12]

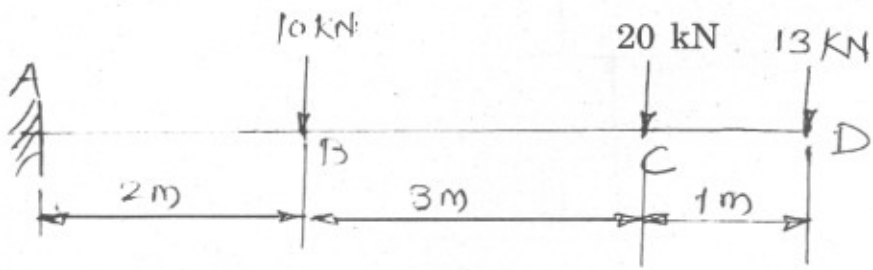


Fig. 5

(*b*) For a cantilever of span 'L' carrying a point load 'W' at its free end, show that the maximum downward deflection is given by :

$$y_{max} = \frac{WL^3}{3EI}.$$ [4]

SECTION II

7. (*a*) A shaft section 100 mm in diameter is subjected to a bending moment of 4000 N.m and a torque of 6000 N.m. Find :

(*i*) the maximum direct stress induced on the section and the plane on which it acts.

(*ii*) What stress-acting alone can produce the same maximum strain ?

Take Poisson's ratio = 0.3. [8]

(*b*) A cylinder of internal diameter 0.5 m and wall thickness of 20 mm with closed ends is subjected simultaneously to an internal pressure of 0.6 MPa, bending moment of 64 kN.m and torque of 16 kN.m. Determine :

(*i*) Principal stresses [2]

(*ii*) Principal stresses due to combined effects of bending and torsion. [2]

(*iii*) Maximum tensile stress and shear stress. [4]

Or

8. (*a*) A thin spherical shell 1 m in diameter with its wall of 1.2 cm thickness is filled with a fluid at atmospheric pressure. What intensity of pressure will be developed in it if 175 cm^3 more of fluid is pumped into it ? Also, calculate the circumferential stress at that pressure and increase in diameter. Take E = 200 GPa and Poisson's ratio = 0.3. [8]

(*b*) Show that in a bar, subjected to an axial load, the instantaneous stress due to sudden application of load is twice the stress caused by gradual application of the load. [8]

9. (*a*) A bar of length 4 m when used as a SSB and subjected to a udl of 30 kN/m over the whole span, deflects 15 mm at the centre. Determine the crippling load when it is used as a column with the following end conditions

(*i*) both ends pin-jointed

(*ii*) one end fixed and other end hinged

(*iii*) both ends fixed. [12]

(*b*) Derive torsion equation, with usual notations as

$$\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{l}.$$ [6]

Or

10. (*a*) A hollow shaft of diameter ratio 3/8 is required to transmits 600 kW at 110 rpm, the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63 MPa and the twist in a length of 3 m is not to exceed 1.4 degrees. Calculate the maximum external diameter satisfying these conditions. Take G = 84 GPa. [12]

(*b*) Derive a relation for the Euler's crippling load for a column having one end fixed and other end free. [6]

11. (*a*) Explain various considerations while designing any machine component. [8]

(*b*) What are the causes of stress concentration and methods to reduce it. [8]

Or

12. (*a*) What do you understand by the following designation of materials :

(*i*) FG 300

(*ii*) 50Cr1V23

(*iii*) 50C4

(*iv*) C40.

Also state one application of each. [8]

(*b*) Define the following terms :

(*i*) Resilience

(*ii*) Toughness

(*iii*) Endurance limit

(*iv*) Fatigue failure. [8]

Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

[3562]-113

S.E. (Mech.) EXAMINATION, 2009

FLUID MECHANICS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *three* questions from each Section.

(*ii*) Answer *three* questions from Section I and *three* questions from Section II.

(*iii*) Answers to the two Sections should be written in separate answer-books.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) Plot the stress strain relation of the various fluids in one diagram and discuss the behaviour of each fluid under an external shear force. [6]

(*b*) If the bulk modulus of elasticity of water is 2.07×10^6 kN/m^2 : [4]

(*i*) What is the pressure required to reduce its volume by 2% ?

(*ii*) What will be the change in mass density ?

(*c*) Describe various types of flow with examples. [6]

P.T.O.

Or

2. (*a*) A body with gravity force of 500N with a flat surface area of 0.2 m^2 slides down a lubricated inclined plane making a 30° angle with the horizontal. For viscosity of 0.1 kg.m/s and body speed of 1 m/s. Determine the lubricant film thickness. [6]

(*b*) Stream function is described as $\psi = x^3 - 3xy^2$. Determine whether the flow is rotational or not. From the following two equations which indicates correct velocity potential ? [6]

(*i*) $\Phi = y^3 - 3x^2y$ and

(*ii*) $\Phi = -3x^2y$.

(*c*) Explain the concept of 'Stream tube' with sketch. [4]

Unit II

3. (*a*) Mass density of a liquid varies as $\rho = (1000 + 0.008\ h)$, where 'h' is depth (m) below free surface of liquid. Determine depth at which gauge pressure would be 100 kPa. [4]

(*b*) Derive an expression for total pressure and centre of pressure for inclined plane submersed in liquid and hence derive the expression for centre of pressure for vertical plane. [8]

(*c*) Define the following terms : [4]

(*i*) Buoyancy

(*ii*) Centre of buoyancy

(*iii*) Principle of floatation

(*iv*) Archimedes' principle.

Or

4. (*a*) Explain with neat sketch the working of single column manometer. [4]

(*b*) A square plate of diagonal 1.5 m is immersed in water with its diagonal vertical and upper corner 0.5 m below the free surface of water. Calculate the depth of the centre of pressure on the plate from the free surface of water and the hydrostatic force resulting on the plate in kN. [8]

(*c*) Explain with neat sketch the method of determining metacentric height of floating body. [4]

Unit III

5. (*a*) A triangular notch discharges under a head of 0.5 m. If the discharge were to be measured within 1% accuracy, how much would be permissible error for head measurement ? [4]

(*b*) Compare Venturimeter and Orifice meter. [6]

(*c*) In a vertical pipe conveying oil of sp.gr. 0.8, two pressure gauges have been installed at A and B, where diameters are 16 cm and 8 cm respectively. B is 2 m above A. The pressure gauge readings have shown that pressure at A is greater than at B. The mercury manometer shows deflection of 100 mm. Neglecting all losses calculate the flow rate. [8]

Or

6. (*a*) A tank containing water is provided with sharp edged circular orifice of 7.5 mm diameter. The height of water in the tank is 1.44 m above the orifice. The jet strikes a wall 1.5 m away and 0.42 m vertically below the centre line of the contracted section of the jet. The actual discharge through the orifice is measured to be 35 litres in 4 minutes. [8]

Determine :

(*i*) Orifice coefficients

(*ii*) The power loss at the orifice.

(*b*) A sub-marine fitted with a Pitot tube moves horizontally in sea with its axis is 12 m below the surface of water. The Pitot tube fixed infront of the sub-marine and along its axis connected to the two limbs of a U-tube containing mercury, the reading of which is found to be 200 mm. Find the speed of the sub-marine.

Take the specific gravity of sea water = 1.025 times fresh water. [6]

(*c*) List the various forces acting on fluid mass. Explain the significance of each term. [4]

SECTION II

Unit IV

7. (*a*) Starting from the first principle, derive the expression for velocity at distance '*y*' from one fixed plate for laminar flow between two parallel fixed plates. Also find the discharge. [10]

(*b*) What are repeating variables ? What points are important while selecting repeating variables ? [6]

Or

8. (*a*) Laminar flow takes place in a circular tube. At what distance from the boundary does the local velocity equal the average velocity ? [8]

(*b*) Torque T of a propeller depends on density of liquid ρ, viscosity of liquid μ, speed of shaft N rpm, linear velocity V, diameter of the propeller shaft D.

Using Buckingham π-theorem, show that :

$$T = \rho N^2 D^5 \Phi(ND/V, \rho ND^2/\mu).$$ [8]

Unit V

9. (*a*) Derive an expression for the power transmission through the pipes. Find also the condition for maximum transmission of power. [6]

(*b*) A siphon of dia. 200 mm connects two reservoirs having a difference of elevation of 20 m. The total length of siphon is 800 m and the summit is 5 m above the water level in the upper reservoir. If separation takes place at 30 kPa (absolute), find maximum length of siphon from upper reservoir to summit. Take friction factor = 0.016, P atm. = 10.3 m of water. [8]

(*c*) Explain briefly the following : [2]

(*i*) Hydraulic grade line (HGL)

(*ii*) Energy grade line (EGL).

Or

10. (*a*) A piping system consists of three pipes arranged in series, the lengths of the pipes are 1200 m, 750 m and 600 m and diameters 750 mm, 600 mm and 450 mm respectively : [8]

(*i*) Transform the system to an equivalent 450 mm diameter pipe, and

(*ii*) Determine an equivalent diameter for the pipe, 2550 m long.

(*b*) Derive Dupit's equation. [4]

(*c*) Explain major and minor losses occurred in pipe. [4]

Unit VI

11. (*a*) Distinguish clearly between hydrodynamically smooth and rough boundaries. [6]

(*b*) State the practical importance of the following boundary layer thickness : [6]

(*i*) Displacement thickness;

(*ii*) Momentum thickness;

(*iii*) Energy thickness.

(*c*) A car of frontal area 1.4 m^2 travels in still air with speed 72 kmph. If drag coefficient is 0.350, calculate the power required to drive the car at this speed. Density of air is 1.2 kg/m^3. [6]

Or

12. (*a*) Explain the significance of the boundary layer concept in fluid mechanics. [6]

(*b*) Explain development of fully developed turbulent flow in circular pipes with sketches. [6]

(*c*) Define 'angle of attack' for an aerofoil. Explain its significance clearly. [6]

Total No. of Questions—12] [Total No. of Printed Pages—8

[3562]-114

S.E. (Mech., Production & S/W) EXAMINATION, 2009

ENGINEERING MATHEMATICS—III

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) In Section I, attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**.

(*iii*) In Section II, attempt Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12**.

(*iv*) Neat diagrams must be drawn whenever necessary.

(*v*) Figures to the right indicate full marks.

(*vi*) Use of non-programmable electronic pocket calculator is allowed.

(*vii*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Solve any *three* of the following : [12]

(*i*) $\left(D^4 + 2D^2 + 1\right) y = xe^{2x}$

(*ii*) $\left(D^2 + 3D + 2\right) y = e^{e^x}$

(*iii*) $\left(D^2 - 6D + 9\right) y = \frac{e^{3x}}{x^2}$, by method of variation of parameters.

(*iv*) $(2x + 1)^2 \frac{d^2y}{dx^2} - 2(2x + 1) \frac{dy}{dx} - 12y = 6x$

(*v*) $\frac{d^3y}{dx^3} + 8y = x^4 + 2x + 1.$

P.T.O.

(*b*) Solve :

$$\frac{dx}{dt} + 2x - 3y = t, \quad \frac{dy}{dt} - 3x + 2y = e^{2t}. \qquad [5]$$

Or

2. (*a*) Solve any *three* of the following : [12]

(*i*) $\frac{d^3y}{dx^3} - \frac{d^2y}{dx^2} = 3x + xe^x$

(*ii*) $\left(D^4 - 1\right) y = \cos x \cosh x$

(*iii*) $\frac{d^2y}{dx^2} + 4y = \tan 2x$, by method of variation of parameters.

(*iv*) $\left(x^3D^3 + 2x^2D^2 + 2\right) y = 10\left(x + \frac{1}{x}\right)$

(*v*) $\left(D^2 + 4\right) y = x \sin x.$

(*b*) Solve :

$$\frac{dx}{x^2 - y^2 - z^2} = \frac{dy}{2xy} = \frac{dz}{2xz}. \qquad [5]$$

3. (*a*) A string is stretched and fastened to two points l apart. Motion is started by displacing the string in the form :

$$u = a \sin \frac{\pi x}{l}$$

from which it is released at time $t = 0$, find the displacement $u(x, t)$ from one end. (Use wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$) [8]

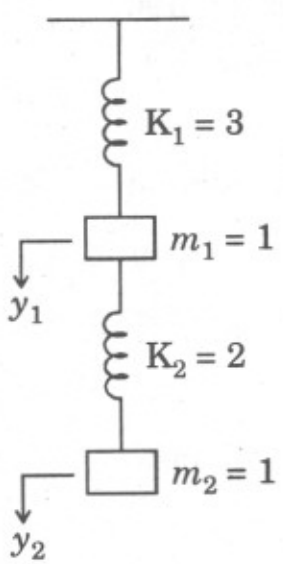
(*b*) The system shown in figure, begins to move with initial displacement :

$$Y_0 = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

and initial velocities :

$$\dot{Y}_0 = \begin{bmatrix} -2\sqrt{6} \\ \sqrt{6} \end{bmatrix}$$

assuming that there is no friction in the system, determine subsequent motion using eigen values. [8]



Or

4. (*a*) Solve the equation : [8]

$$\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} = 0$$

with the conditions :

(*i*) $v = 0$ when $y \to +\infty$ for all x.

(*ii*) $v = 0$ when $x = 0$ for all values of y.

(*iii*) $v = 0$ when $x = 1$ for all values of y.

(*iv*) $v = x(1 - x)$ when $y = 0$ for $0 < x < 1$.

(*b*) If 3 kgs weight streches a spring 15 cms. and if the weight is pulled 10 cms. below equilibrium position and is then given a downward velocity of 60 cms/sec. instead of being released from rest. Determine the amplitude, period and the frequency of the motion considering the differential equation of the motion as :

$$\frac{d^2x}{dt^2} + \frac{196}{3}x = 0. \qquad [8]$$

5. (*a*) Find the Fourier Sine and Cosine transforms of :

$$\begin{aligned} f(x) &= x \quad , 0 \leq x \leq 1 \\ &= 2 - x \quad , 1 \leq x \leq 2 \\ &= 0 \quad , x > 0. \end{aligned} \qquad [6]$$

(*b*) Find the Laplace Transform of the following (any *two*) : [6]

(*i*) $\dfrac{e^{-2t} \sin 2t}{t}$

(*ii*) $\dfrac{\cos \sqrt{t}}{\sqrt{t}}$

(*iii*) $\displaystyle\int_0^t \frac{1 - e^{-x}}{x}\, dx.$

(*c*) Using Laplace Transforms, solve the following differential equation :

$$y''' - y = e^t,\ y(0) = y'(0) = y''(0) = 0. \qquad [5]$$

Or

6. (*a*) Solve the following integral equation :

$$\int_0^\infty f(x) \sin \lambda x \, dx = 1 - \lambda, \quad 0 \le \lambda \le 1$$

$$= 0 \quad , \lambda > 1. \qquad [6]$$

(*b*) Find Inverse Laplace Transforms of the following (any *two*) : [6]

(*i*) $\dfrac{1}{s(s^2 + 4)}$

(*ii*) $\dfrac{11s^2 - 2s + 5}{(s - 2)(2s - 1)(s + 1)}$

(*iii*) $\tan^{-1}(s + 1)$.

(*c*) Using Laplace Transforms, solve the following differential equation :

$$\frac{dy}{dt} + 3y(t) + 2\int_0^t y(t)\, dt = t,$$

given $y(0) = 0$. [5]

SECTION II

7. (*a*) The first four central moments of distribution are 0, 2.5, 0.7 and 18.75, find β_1 coefficient of skewness and β_2 coefficient of kurtosis. [4]

(*b*) If the two lines of regression are $9x + y - \lambda = 0$ and $4x + y = \mu$, the means of x and y are 2 and –3 respectively. Find the values of λ and μ and the coefficient of correlation between x and y. [7]

(*c*) In a certain factory turning out razor blade, there is a small chance of $\frac{1}{500}$ for any blade to be defective. The blades are supplied in a packet of 10, use Poisson distribution to calculate the approximate number of packets containing no defective and two defective blades in a consignment of 10000 packets. [6]

Or

8. (*a*) On an average a box containing 10 articles is likely to have 2 defectives. If we consider a consignment of 100 boxes, how many of them are expected to have three or less defectives ? [5]

(*b*) Obtain regression lines for the following data : [7]

x	y
6	9
2	11
10	5
4	8
8	7

(*c*) Assuming that the diameter of 1000 brass plugs taken consecutively from machine form a normal distribution with mean 0.7515 cm and standard deviation 0.0020 cm. How many of the plugs are likely to be approved if the acceptable diameter is 0.752 ± 0.004 cm ? [5]

9. (*a*) A curve is given by the equation $x = t^2 + 1$, $y = 4t - 3$, $z = 2t^2 - 6t$, find the angle between tangents at $t = 2$ and $t = 3$. [5]

(*b*) Find the function $f(r)$ so that $f(r)\bar{r}$ is solenoidal, also show that function $f(r)\bar{r}$ is always irrotational. [6]

(*c*) Attempt any *two* of the following : [6]

(*i*) For scalar functions ϕ and ψ, show that :

$$\nabla^2(\phi\psi) = \phi\nabla^2\psi + 2\nabla\phi \cdot \nabla\psi + \psi\nabla^2\phi.$$

(*ii*) For a solenoidal vector field $\overline{E}$, show that :

$$\text{curl curl curl curl } \overline{E} = \nabla^4 \overline{E}.$$

(*iii*) Show that $\nabla^4(r^2 \log r) = \frac{6}{r^2}$.

Or

10. (*a*) Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2, -1, 2)$ in the direction $2\bar{i} - 3\bar{j} + 6\bar{k}$. [5]

(*b*) Show that :

$$\overline{F} = (y \sin z - \sin x)\bar{i} + (x \sin z + 2yz)\bar{j} + \left(xy \cos z + y^2\right)\bar{k}$$

is irrotational and find scalar function ϕ such that $\overline{F} = \nabla\phi$. [6]

(*c*) Show that :

$$\nabla^2\left[\nabla \cdot \left(\frac{\bar{r}}{r^2}\right)\right] = \frac{2}{r^4}.$$ [6]

11. (*a*) Evaluate :

$$\iint_s \left(x^3\bar{i} + y^3\bar{j} + z^3\bar{k}\right) \cdot d\bar{s}$$

where s is the surface of the sphere $x^2 + y^2 + z^2 = 9$. [6]

(*b*) Find the work done in moving a particle once round the ellipse :

$$\frac{x^2}{25} + \frac{y^2}{16} = 1,$$

$z = 0$ under the field of force given by :

$\overline{F} = (2x - y + z)\bar{i} + (x + y - z^2)\bar{j} + (3x - 2y + 4z)\bar{k}$. [6]

(*c*) Velocity distribution for a fluid flow is given by $u = -x$, $v = 2y$ and $w = 3 - z$, find the equation of streamline passing through the point (1, 1, 2). [4]

Or

12. (*a*) Evaluate :

$$\iint_s 2x^2y\, dy\, dz - y^2\, dz\, dx + 4xz^2\, dx\, dy$$

over the curved surface of the cylinder $y^2 + z^2 = 9$, bounded by $x = 0$ and $x = 2$. [6]

(*b*) Verify Stokes' theorem for :

$$\overline{F} = x^2\bar{i} + xy\bar{j}$$

for the surface of a square lamina bounded by $x = -1$, $x = 1$, $y = -1$, $y = 1$. [6]

(*c*) Show that the velocity potential :

$$\phi = \frac{1}{2}a\left(x^2 + y^2 - 2z^2\right)$$

satisfies the Laplace's equation. Also determine the stream-lines. [4]

Total No. of Questions—12] [Total No. of Printed Pages—4+2

[3562]-115

S.E. (Mechanical Engineering) EXAMINATION, 2009

MANUFACTURING PROCESSES-I

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions form Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Draw only "Pit furnace" and show the following parts on it : [4]

(*i*) Crucible containing metal

(*ii*) Coke

(*iii*) Fire Brick

(*iv*) Chimney.

(*b*) Explain briefly horizontal and vertical type core with suitable diagram. [4]

(*c*) Define pattern, pattern material, types of pattern and list the various allowances on pattern. [4]

(*d*) Explain concept of "Centrifugal casting" with suitable diagram also write down limitations of the process. [4]

P.T.O.

Or

2. (*a*) Explain the following defects in casting component with their causes and remedies : [4]

(*i*) Mismatch

(*ii*) Blow holes

(*iii*) Cold shuts and misrun

(*iv*) Variation in wall thickness.

(*b*) Describe shell moulding procedure with suitable sketch. [4]

(*c*) Differentiate between "parting and baking sand" with respect to properties and application. [4]

(*d*) Explain construction and working of "Tilting Furnace" with suitable diagram. [4]

3. (*a*) Compare hot working and cold working process. [4]

(*b*) Explain principle of spinning operation. Also mention *one* example as a product of spinning operation. [4]

(*c*) Describe the following sheet metal operation with the help of suitable diagram : [4]

(*i*) Blanking

(*ii*) Drawing.

(*d*) Explain working principle of forward and backward extrusion process. [4]

Or

4. (*a*) Explain working principle of progressive dies with suitable sketch. [4]

(*b*) Describe HERF process used in forming the sheet metal workpiece. [4]

(*c*) Explain wire drawing principle with suitable diagram. [4]

(*d*) Name the various driving mechanisms of presses also explain working of "Eccentric drive" with sketch. [4]

5. (*a*) Differentiate between spot and seam resistance welding process. [4]

(*b*) Explain "Thermit welding" with suitable sketch. [4]

(*c*) Describe SMAW principle, working and set up with suitable diagram. [10]

Or

6. (*a*) Differentiate between soldering and brazing process. [4]

(*b*) Describe the principle of "Ultrasonic welding" with suitable diagram. [4]

(*c*) Describe Gas metal arc welding (GMAW) with principle, working and set up diagram. [10]

SECTION II

7. (*a*) Draw block diagram of lathe machine and show the following parts on it :

(*i*) Simple or compound gear train [4]

(*ii*) Lead screw.

(*b*) Find the time required for one complete cut on a lathe of work 350 mm long and 50 mm diameter. The cutting speed is 35 m/min and feed is 0.5 mm/rev. [4]

(*c*) Large diameter D = 90 mm, small diameter d = 80 mm and length of work is 100 mm. Find angle of taper. [4]

(*d*) Differentiate between single start and multistart threads. [4]

Or

8. (*a*) Draw only set-up of taper turning by swivelling the compound rest, also write down limitations of the method. [4]

(*b*) Calculate the gears and sketch the gear train for cutting 2 mm pitch double start right hand threads on a lathe with 6 mm pitch lead screw. Available gears are 20 to 120 in step for five teeth. [4]

(*c*) Explain purpose of the following accessories used for turning operation : [4]

(*i*) Angle plate

(*ii*) Lathe carrier.

(*d*) Draw *three* views of single point cutting tool and show the following angles and elements on it : [4]

(*i*) Side flank

(*ii*) Cutting edge

(*iii*) Back rake angle

(*iv*) End relief angle.

9. (*a*) Define indexing. List the various methods of indexing. Write down advantages and limitations of direct indexing method. [4]

(*b*) Describe the following milling cutters with suitable diagram : [4]

(*i*) Form milling cutter

(*ii*) Angular cutter

(*c*) Differentiate between gang and multispindle methods of drilling. [4]

(*d*) Explain construction working of universal dividing head used for indexing. [6]

Or

10. (*a*) Index 69 divisions by using compound indexing method and write down movement of index crank and index plate. Following index plate given : [6]

Plate No 1 — 15, 16, 17, 18, 19 and 20 holes

Plate No. 2 — 21, 23, 27, 29, 31 and 33 holes

Plate No. 3 — 37, 39, 41, 43, 47 and 49 holes.

(*b*) Describe the following milling operations with suitable diagram : [4]

(*i*) T-slot milling

(*ii*) Straddle milling

(*c*) Explain the following types of drilling operations : [4]

(*i*) Counterboring

(*ii*) Countersinking.

(*d*) Differentiate between boring and reaming operation. [4]

11. (*a*) Explain the working principle of "Centerless Grinding" process. [4]

(*b*) Explain I.S. systems for marking the grinding wheel. [4]

(*c*) Differentiate between lapping and honing process. [4]

(*d*) Describe thread grinding process with diagram. [4]

Or

12. (*a*) On grinding wheel, it is printed as under : [4]

W–S–30–R–7–V–17

Explain in each case. What each letter and number indicate ?

(*b*) Explain construction of internal cylindrical centerless grinding machine with principle sketch. [4]

(*c*) Explain the following super finishing process : [4]

(*i*) Polishing

(*ii*) Buffing.

(*d*) Explain factors for selection of grinding wheel (any *four*) : [4]

Total No. of Questions—**12**] [Total No. of Printed Pages—**7**

[3562]-117

S.E. (Mechanical) EXAMINATION, 2009

I.C. ENGINE AND AUTOMOBILE ENGINEERING

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) Draw a neat sketch of a four-stroke S.I. engine, label the parts and explain their functions. [10]

(*b*) An engine working on Otto cycle has clearance volume of 0.03 m^3 and stroke volume of 0.12 m^3. Assume $\gamma = 1.4$ for air, calculate :

(*i*) Compression ratio

P.T.O.

(*ii*) Air standard efficiency

(*iii*) Change in air standard efficiency if C_v increased by 1.8%. [8]

Or

2. (*a*) Explain the effects of operating variables on the performance of the cycle. [10]

(*b*) What are the various losses which make the operation of actual engine cycle different from that of air standard cycle ? [8]

Unit II

3. (*a*) What are the requirements of a good carburettor ? Explain the working of a Solex carburettor with the help of a neat sketch. [8]

(*b*) What are the various types of fuel injection systems used in C.I. engines ? Explain any *one* with the help of a neat sketch. [8]

Or

4. (*a*) Why is MPFI system used in modern automobiles in SI engines ? Explain with the help of block diagrams the various controls of a MPFI injection system used in SI engines. [8]

(*b*) What are the objectives of a direct injection system ? [3]

(*c*) What are the types of fuel injectors ? Explain the working of an automatic fuel injector with the help of a neat sketch. [5]

Unit III

5. (*a*) Explain the working of a magneto ignition system with the help of a neat sketch. What are the advantages of this system compared to battery ignition system ? [8]

(*b*) What are the various requirements of an ideal lubricant ? [4]

(*c*) Why is governing of I.C. engines required ? List the methods used for governing of I.C. engines. [4]

Or

6. (*a*) Differentiate between wet sump lubrication and dry sump lubrication. [3]

(*b*) Explain the working of spring loaded mechanical governor with the help of neat sketch used for diesel engines. [8]

(*c*) Why are thermostat, radiator and fan used in cooling system ? [5]

SECTION II

Unit IV

7. (*a*) A four cylinder four-stroke diesel engine develops 75 kW and consumes 20.4 kg diesel per hour. The C.V. of diesel is 45000 kJ/kg. The water supplied to the engine jacket on its exit enters an exhaust gas calorimeter. The following observations are made :

Mass of water circulated to jacket = 25 kg/min

Temperature of water entering jacket = 27°C

Temperature of water leaving jacket = 66°C

Temperature of water leaving the exhaust gas calorimeter = 91°C

Temperature of exhaust gases leaving the engine = 410°C

Temperature of exhaust gases leaving the exhaust gas calorimeter = 160°C

Room temperature = 27°C.

Calculate brake thermal efficiency. Draw heat balance on minute basis and percentage basis. [10]

(*b*) What are I.C. engine performance characteristics ? How are they used for engine performance evaluation ? [8]

Or

8. (*a*) A trial carried out on a 6-cylinder 4-stroke petrol engine gave the following results :

Orifice diameter = 25 mm

Brake power = 70 kW

Diameter of cylinder bore = 90 mm

Stroke = 100 mm

Atmospheric pressure = 76 cm of Hg

Pressure drop across orifice = 16 cm of Hg

Coefficient of discharge = 0.62

Stoichiometric air-fuel ratio = 15.3

Fuel consumption = 10^{-4} m^3 in 30 sec.

Atmospheric temperature = 30°C

Density of fuel = 800 kg/m^3

Engine speed = 2500 r.p.m.

Calculate :

(*i*) BSFC

(*ii*) Actual air-fuel ratio

(*iii*) % excess air supplied

(*iv*) Volumetric efficiency. [10]

(*b*) What is turbo-charging ? Explain the thermodynamic cycle with turbo-charging. [8]

Unit V

9. (*a*) Explain with neat sketch main stages of combustion in SI engines. [8]

(*b*) What are the effects of engine variables on the ignition delay period in diesel engines ? [8]

Or

10. (*a*) What are the requirements of combustion chambers for SI engines ? Explain any *one* type of combustion chamber used in SI engine with a neat sketch. [8]

(*b*) Explain knocking in SI engine. What are the harmful effects of knocking ? [8]

Unit VI

11. (*a*) What are the pollutants from emissions of a CI engine and SI engine ? State their permissible limits as per EURO III standards. [10]

(*b*) What are the main components of hybrid electric vehicle ? Explain in brief the future of hybrid vehicles. [6]

Or

12. (*a*) What are the various requirements of engine for automotive applications ? [8]

(*b*) Explain with the help of a diagram, exhaust gas recirculation system. [8]

Total No. of Questions—**12**] [Total No. of Printed Pages—**4+2**

[3562]-118

S.E. (Mech./Prod.) EXAMINATION, 2009

ELECTRICAL TECHNOLOGY

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer books.

(*ii*) Answer Q. No. **1** or Q. No. **2**; Q. No. **3** or Q. No. **4**; Q. No. **5** or Q. No. **6**, Q. No. **7** or Q. No. **8**; Q. No. **9** or Q. No. **10** and Q. No. **11** or Q. No. **12**.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of non-programmable pocket size scientific calculator is permitted.

(*v*) Neat diagrams must be drawn wherever necessary.

(*vi*) Assume suitable additional data, if necessary.

SECTION I

1. (*a*) What are types of d.c. generators ? Draw the connection diagram of each. Also write down voltage equation for each and state applications of each. [10]

(*b*) A 230 V d.c. shunt motor draws current of 16 amp on a certain load. The armature resistance is 1 Ω and field resistance is

P.T.O.

230 Ω. Find the resistance required in series with the armature to halve the speed if the load torque is proportional to square of speed. [8]

Or

2. (*a*) Why is starter necessary for a D.C. shunt motor ? Explain with neat connection diagram, working of a three point starter. [10]

(*b*) Explain any *four* methods of speed control of d.c. series motor. [8]

3. (*a*) Two wattmeters are connected to measure total input power in a 3-phase, star-connected balanced inductive circuit. Derive the equations for reading on each wattmeter. Draw the neat connection diagram of relevant phasor diagram. [8]

(*b*) Three identical coils are connected in delta across 3-phase, 400 V, 50 Hz A.C. supply. Each coil consists of resistance of 20 Ω and inductance of 0.0636 H. Calculate the p.f. of load, line current drawn and readings on the two wattmeter readings connected to measure the total power. [8]

Or

4. (*a*) Explain factors to be considered while designing a factory lighting. [4]

(*b*) What are the advantages of higher p.f. of electrical load ? [4]

(*c*) Explain with neat connection diagram, how reactive power can be measured for a 3-phase balanced load using one wattmeter method. Draw the phasor diagram also. [8]

5. (*a*) Compare salient pole and non-salient pole alternator. [4]

(*b*) Derive the expression for coil-span factor for alternator. [4]

(*c*) Explain the synchronous impedance method for calculating the regulation of 3-phase alternator. [8]

Or

6. (*a*) Write short notes on : [8]

(*i*) Welding transformer

(*ii*) Potential transformer.

(*b*) A 3-phase 4-pole star-connected alternator is driven at the speed of 1800 r.p.m. The armature coils are sorted by one

slot and coil span being 165° elect. If there are 12 conductors per slot and flux per pole is 50 mwb, calculate the value of the induced e.m.f. across the terminals of the alternator. [8]

SECTION II

7. (*a*) Derive the torque equation and hence obtain the condition for maximum torque and sketch the T-slip characteristic for three-phase induction motor. [10]

(*b*) A 20 h.p., 3-phase, 415 V, 50 Hz induction motor runs at 1455 r.p.m. at full load. At this load stator losses are 750 watt and mechanical losses are 600 watt. Calculate the efficiency of motor at full load. [8]

Or

8. Attempt any *three* :

(*i*) Compare squirrel cage and slip-ring type rotor construction for induction motor.

(*ii*) Neat sketch and working of star-delta starter used for induction motor.

(*iii*) Neat sketch and working of rotor-resistance starter used for induction motor.

(*iv*) Any *two* methods of speed control of three-phase induction motor. [18]

9. (*a*) With neat construction diagram explain working of shaded pole single phase induction motor. [6]

(*b*) Write short notes on :

(*i*) Permanent magnet type stepper motor and

(*ii*) Universal motor. [10]

Or

10. (*a*) Write short notes on : [10]

(*i*) D.C. servomotor and

(*ii*) Reluctance motor.

(*b*) Explain the working principle and state the applications of Hysteresis motor. [6]

11. (*a*) Explain various methods of electric heating. State advantages of electric heating over other. [8]

(*b*) Explain with neat sketch working of A_{jax}-W_{yatt} furnace. [8]

Or

12. (*a*) State any *two* applications of :

(*i*) D.C. shunt motor

(*ii*) D.C. series motor

(*iii*) 3-Ph squirrel cage induction motor and

(*iv*) 3-phase slip-ring induction motor. [8]

(*b*) A 3-phase 440 volt, star-connected 42 kW resistance oven is used a nichrome strip as a heating element. The resistivity of nichrome is 1.03×10^{-6} Ω-m. Determine the width and length of strip if its thickness is 0.26 mm. The working temperature for strip is 1127°C and that of charge is 727°C. Assume emissivity as 0.9 and radiating efficiency is 60%. [8]

Total No. of Questions—**12**] [Total No. of Printed Pages—**4+2**

[3562]-119

S.E. (Mechanical) EXAMINATION, 2009

METALLURGY

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6** from Section I and Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12** from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Distinguish between Screw and Edge dislocation. Also explain the effects of point defects on various properties of materials. [6]

(*b*) Is cold working always superior to hot working ? Explain. [4]

(*c*) Derive an expression for CRSS of a single crystal. Calculate resolved shear stress of a single crystal if applied tensile stress is 30 kg/mm^2 and slip plane is oriented at 45° to the tensile axis ? [6]

P.T.O.

Or

2. (*a*) What is a slip system ? Why is copper more ductile than Iron ? [4]

(*b*) Why strain hardening is more in fine grained material ? [3]

(*c*) Explain the following in brief (any *three*) : [9]

(*i*) Point defects

(*ii*) Recrystallisation

(*iii*) Polygonization

(*iv*) Dislocation.

3. (*i*) What is Barba's law ? What is its significance ? Derive the relationship between :

(*a*) engineering stress and true stress

(*b*) engineering strain and true strain. [6]

(*ii*) Which NDT method do you suggest to sort out steel bars of same shape and size but with different chemical composition ? Explain only the principle of that test. [4]

(*iii*) Draw a typical S-N curve for Al and Steel. Explain why these curves differ from each other. Define fatigue limit. [6]

(*iv*) Which hardness test do you recommend for High speed steel tool Gray iron casting ? [2]

Or

4. (*a*) Explain what is Creep ? When it is of great significance ? Draw a typical creep curve. [6]

(*b*) Differentiate between Charpy and Izod impact test. [5]

(*c*) Draw a typical fatigue fracture. Suggest ways to improve fatigue life of a component. [5]

(*d*) Draw typical engineering stress-engineering strain curves for mild steel and copper. [2]

5. (*a*) Draw $Fe\text{-}Fe_3C$ equilibrium diagram (not to scale but proportionate). Give all the details on it. (No written explanation is required) Write various reactions of $Fe\text{-}Fe_3C$ system with all details. [6]

(*b*) Define Ferrite, Pearlite, Cementite and Killed steel. [4]

(*c*) Which steel would you recommend for the following applications ? Justify your choice (any *three*) : [6]

(1) Household utensils

(2) RCC bars

(3) Crankshaft

(4) Master gauge

(5) Nuts.

Or

6. Answer the following : [16]

(*a*) Distinguish between Killed and Rimmed steel.

(*b*) Draw the microstructure of AISI 1080 steel which is cooled to room temperature under equilibrium cooling condition. Find amounts of phases in it.

(*c*) Discuss the effects of Tungsten and Chromium on properties of steel.

(*d*) Which steel do you suggest for the following applications ? Justify your choice (any *two*) :

(1) Milling cutter

(2) Taps

(3) Fan blades

(4) Surgical Instruments.

SECTION II

7. (*a*) State True/False and justify (any *four*) : [12]

(1) Hypereutectoid steels are hardened from above Acm temperature.

(2) Hardness increases during tempering.

(3) Annealed steel is harder than normalised steel.

(4) Heat treatment is not required after carburising.

(5) Plain carbon steels cannot be successfully nitrided.

(*b*) What is carbonitriding ? Explain in brief stating its advantages over carburising. [6]

Or

8. (*a*) Differentiate between Carburising and Nitriding. [4]

(*b*) What is Tempering ? Is it mandatory ? With a suitable graph, explain the variations in properties with tempering temperature. [6]

(*c*) What is Hardenability ? How is it measured ? [4]

(*d*) Distinguish between TTT and CCT diagram. [4]

9. (*a*) Suggest suitable non-ferrous material for the following applications (any *four*), mention composition also : [8]

(1) Coins

(2) Piston

(3) Turbine blades

(4) Costume Jewellery

(5) Bell

(6) Gun barrel.

(*b*) Compare S.G. iron and Malleable iron with respect to micro-structure, production, composition and *one* application. [8]

Or

10. (*a*) In what respect cast iron is different than steel ? [3]

(*b*) White cast iron finds limited applications in engineering in industries. Do you agree/disagree ? Justify your choice. [3]

(*c*) Suggest suitable non-ferrous material for the following applications (any *five*), mention composition also : [10]

(1) Imitation Jewellery

(2) Piston

(3) Cylinder head of diesel engine

(4) Bearings to be used in sea water

(5) Thermocouple wire

(6) Non-sparking tools

(7) Aircraft components

(8) Measuring tape.

11. (*a*) Explain the following terms : [6]

(*i*) Apparent density

(*ii*) Compressibility

(*iii*) Green spring.

(*b*) What is sintering ? Explain in brief. [4]

(*c*) With a neat sketch, explain working of total radiation pyrometer. Mention its working range of temperature. [6]

Or

12. Write short notes on (any *four*) : [16]

(1) Cemented carbides;

(2) Particle size and its distribution

(3) Types of thermocouple

(4) Optical pyrometer

(5) Atomization

(6) Advantages of Powder Metallurgy.

Total No. of Questions—**12**] [Total No. of Printed Pages—**4+2**

[3562]-120

S.E. (Mechanical) EXAMINATION, 2009

MANUFACTURING PROCESSES—II

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the *two* sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) A seamless tube of 50 mm outside diameter is turned on lathe with cutting speed of 20 m/min. The tool rake angle is 15° and feed rate is 0.2 mm/rev. The length of chip in one revolution measures 80 mm. Calculate : [8]

(*i*) Chip thickness ratio

(*ii*) Shear plane angle

(*iii*) Shear flow speed

(*iv*) Shear strain.

P.T.O.

(*b*) Prove that $T = \left(\frac{1}{n} - 1\right) K_2$, where 'T' is a tool life for maximum production, '*n*' is the exponent in the tool life equation and K_2 is the tool changing time. [8]

Or

2. (*a*) During machining of C-25 steel with 0-10-6-6-8-90-1 (ORS) shaped tripple carbide cutting tool. The following observation have been made :

Depth of cut = 2 mm, Feed = 0.2 mm/rev.

Speed = 200 m/min, Tangential Force = 1600 N,

Feed thrust force = 850 N, Chip thickness = 0.39 mm

Calculate :

(*i*) Shear force

(*ii*) Normal force at shear plane

(*iii*) Friction force

(*iv*) Kinetic co-efficient of friction

(*v*) Specific cutting energy. [10]

(*b*) State and explain Merchant's circle of cutting force. [6]

3. (*a*) Explain various types of broaching machines. [8]

(*b*) What are the different methods of thread manufacturing ? Explain any *two* with neat sketch. [8]

Or

4. (*a*) Explain gear hobbing process with neat sketch. [6]

(*b*) Explain the major disadvantages of self opening die heads (Thread chasers). [4]

(*c*) Explain with neat sketch Broach Geometry. [6]

5. (*a*) Define NC. State the advantages of NC machines over conventional machine tool. [6]

(*b*) Draw block diagram of DNC system. Compare DNC and CNC systems. [6]

(*c*) Write the functions of the following codes : [6]

(*i*) G03

(*ii*) G71

(*iii*) M04

(*iv*) M30

(*v*) M06

(*vi*) G00

Or

6. (*a*) Write short note on FMS. [6]

(*b*) Explain the meaning of every word written in the following programming line. [6]

G01 G94 X25 Z–20 M03 T01 F50

(*c*) Write short note on ATC. [6]

SECTION II

7. (*a*) Explain with neat sketch Electro-discharge Machining Process. What are its advantages and disadvantages. [6]

(*b*) Draw self-explanatory diagram of AJM. [4]

(*c*) Explain Electron Beam Machining process with neat sketch. [6]

Or

8. (*a*) What is the function of electrolyte in ECM ? List the common electrolyte used in ECM. [4]

(*b*) Explain with neat sketch USM. State its process characteristics. [6]

(*c*) What is LASER ? Explain how laser is used to machine the parts with neat sketch. [6]

9. (*a*) A square washer with 10 mm internal hole and 25 mm outer square is to be made from 1.5 mm thick strip of 0.2 per cent carbon steel on progressive die.

Given : Ultimate shear strength = 250 N/mm^2

Penetration = 60% of sheet thickness

Clearance = 6% of sheet thickness. [10]

(*i*) Find out cutting force without staggering and no shear.

(*ii*) Find out cutting force with staggering and no shear.

(*iii*) Find out cutting force with staggering and with full shear (i.e. 1.5 mm shear).

(*iv*) Comment on the above answers.

(*v*) Punch and die size at blanking station.

(*b*) Explain the difference between coining and embossing. [3]

(*c*) Sketch compound die. [3]

Or

10. (*a*) A cylindrical cup of mean diameter 50 mm and mean height 50 mm with corner radii 2 mm is to be made from cold rolled steel of 0.8 mm thick.

Calculate :

(*i*) Blank size

(*ii*) No. of draws required

(*iii*) Cup diameter after first draw with 45% reduction. [6]

(*b*) What is pilot ? What is its function ? Explain types of pilots. [5]

(*c*) What is strip layout ? What factor should be considered during strip layout. [5]

11. (*a*) Define jigs and fixtures and explain the difference between them. [6]

(*b*) Write short notes on : [12]

(*i*) Milling Fixture

(*ii*) 3-2-1 principle of location.

12. Write short notes on (any *three*) : [18]

(*i*) Quick acting clamp

(*ii*) Method of locating works

(*iii*) Renewable and slip bush

(*iv*) Indexing method used in jig.