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

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S.E. (Mech.) (First Semester) EXAMINATION, 2008

APPLIED THERMODYNAMICS

(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*) Find COP and heat transfer rate in a condenser of a refrigerator having capacity 12000 kJ/hour when power consumed is 0.75 kW. [4]

(*b*) Discuss equivalence of Clausius and Kelvin-Planck statement. [6]

(*c*) Prove that change of entropy can be obtained by : [6]

$$S_2 - S_1 = C_p \ln(T_2/T_1) - R \ln(P_2/P_1).$$

Or

2. (*a*) What is Clausius inequality ? [6]

P.T.O.

(*b*) A 30 kg copper block, C_P = 0.386 kJ/kgK at 95°C is dropped in 30 litres of water at 24°C. Find final equilibrium temp. and entropy generation. [6]

(*c*) Discuss in brief Carnot cycle and show it on P-V and T-S planes. [4]

3. (*a*) During an experiment to decide specific heat capacities of 50 gm air, it was heated from 14°C to 74°C for 300 seconds. Heat consumed 10.04 W. Find out C_P, C_V, R and density of air at 0°C and 100 kPa. [8]

(*b*) Derive the expression for air standard efficiency of Diesel cycle. [6]

(*c*) Compare Otto and Diesel cycles on the basis of same compression ratio and max. temperature. [4]

Or

4. (*a*) For a duel cycle, temp. of air at start is 35°C. Ratio of max. and min. pressure is 70 and compression ratio is 15. Amount of heat added in constant pressure and volume processes is same. Find out air standard efficiency. [8]

(*b*) Air is compressed from 100 kPa and 17°C to 600 kPa and 57°C. Determine entropy change.
If initial conditions are maintained and compression is isentropic, find out final temperature. [6]

(*c*) What is the difference between throttling and free expansion ? [4]

5. (*a*) Steam at 28 kPa passes into a condenser and leaves as condensate of 59°C. Rate of cooling water is 45 kg/min, temperature rise of water is 15°C. If mass flow of steam is 1.25 kg/min, find out dryness fraction of steam at condenser entry. [6]

(*b*) Compare Carnot cycle and Rankine cycle. [4]

(*c*) What do you understand by work ratio and specific steam consumption ? [2]

(*d*) With neat sketch explain any *one* method of measuring dryness fraction. [4]

Or

6. (*a*) In a steam power plant steam at 15 bar is supplied and condenser pressure is at 0.3 bar. Decide Rankine efficiency and specific steam consumption if : [10]

(*i*) Steam is dry at entry;

(*ii*) Superheated at 400°C before entry to turbine.

(*b*) Explain effect of superheating, inlet pressure and back pressure on performance of Rankine cycle. [6]

SECTION II

7. (*a*) Draw p-v and T-s diagram for a single stage reciprocating air compressor, without clearance. Derive the expression for the work done when compression is (*i*) isothermal, and (*ii*) isentropic. [6]

(*b*) A single acting two stage compressor with complete intercooling delivers 10 kg/min of air at 16 bar. The suction occurs at 1 bar and 15°C. The compression and expansion processes are reversible polytropic with polytropic index n = 1.25. Calculate : [10]

(*i*) The power required

(*ii*) The isothermal efficiency

(*iii*) The free air delivery

(*iv*) Heat transferred in intercooler

(*v*) If the clearance ratios for LP and HP cylinders are 0.04 and 0.06 respectively, calculate the swept and clearance volumes for each cylinder. The compressor runs at 400 rpm.

Or

8. (*a*) Explain throttle control of compressors. [4]

(*b*) A three stage reciprocating air compressor compresses air from 1 bar and 17°C to 35 bar. The law of compression is $pV^{1.25} = C$ and is the same for all the stages of compression. Assuming perfect intercooling, neglecting clearance, find the minimum power required to compress 15 m^3/min of free air. Also find the intermediate pressures. [6]

(*c*) A single stage, single acting air compressor delivers 15 m^3/ min of free air from 1 bar to 8 bar at 300 rpm. The clearance volume is 6% of the stroke volume and compression and expansion follow the law $pV^{1.3} = C$. Calculate the diameter and stroke of the compressor. Take L/D = 1.5. The temperature and pressure of air at suction are the same as that of free air. [6]

9. (*a*) Define equivalence ratio. How the concept of mixture strength related to rich and weak mixtures of fuel and air ? [4]

(*b*) State and explain various physical laws of combustion. [6]

(c) The percentage composition (by mass) of a certain fuel is C = 88%, H_2 = 3.6%, O_2 = 4.8% and ash 3.6%. The percentage composition (by volume) of the flue gases are CO_2 = 10.9%. CO = 1%, O_2 = 7.1% and N_2 = 81%. Determine :

(i) the mass of air actually supplied per kg of fuel, and

(ii) the percentage excess air supplied. [6]

Or

10. (a) How does the presence of N_2 in the air affect the out of a combustion process ? [4]

(b) Explain the method of writing the complete combu equation of a fuel with air with the help of an exan [5]

(c) The following observations were made during a test on gas : [7]

Volume of gas used	=	0.06 m^3
Mass of cooling water circulated	=	9.8 kg
Mass of condensed steam collected	=	0.009 kg
Rise in temperature of cooling water	=	6.3°C
Pressure of gas tested above atmosphere	=	45 mm of wa
Temperature of gas tested	=	14°C
Barometric pressure	=	750 mm of H

Calculate the higher and lower calorific values at N.T

11. (*a*) Write a short note on IBR boilers. [5]

(*b*) A 30 m high chimney is used to discharge hot gases at 297°C to the atmosphere which is at 27°C. Find the mass of air actually used per kg of fuel, if the draught produced is 15 mm of water. If the coal burnt in the combustion chamber contains 80% carbon, 6% moisture and remaining ash, determine the percentage of excess air supplied. [6]

(*c*) The following particulars were recorded during a steam boiler trial : [7]

Pressure of steam = 11 bar, mass of feed water = 4600 kg/hr, temperature of feed water = 75°C, dryness fraction of steam = 0.96, coal used = 490 kg/hr, calorific value of coal = 35700 kJ/kg, moisture in coal = 4% by mass, mass of dry flue gases = 18.57 kg/kg of coal, temperature of flue gases = 300°C, boiler house temperature = 16°C, specific heat of flue gases = 0.97 kJ/kgK. Draw the heat balance sheet of the boiler per kg of coal.

Or

12. (*a*) Are unavailable energy and irreversibility basically the same thing ? If not, how do they differ ? [6]

(*b*) What is the second law efficiency ? How does it differ from the first law efficiency ? [5]

(*c*) Calculate the decrease in available energy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of the surroundings being 15°C (C_p of water = 4.2 kJ/kgK). [7]

Total No. of Questions—12] [Total No. of Printed Pages—8+4

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S.E. (Mech.) (First Sem.) EXAMINATION, 2008

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

Unit 1

1. (*a*) Define the following terms :

(*i*) Factor of safety.

(*ii*) Modulus of rigidity.

(*iii*) Thermal stress.

(*iv*) Volumetric strain. [4]

P.T.O.

(*b*) Two vertical wires are suspended at a distance of 500 mm apart as shown in Fig. 1 below. Their upper ends are firmly secured and their lower ends support a rigid horizontal bar which carries a load 'W'. The left wire has a diameter of 1.6 mm and is made of copper and the right wire has a diameter of 0.9 mm and is made of steel. Both wires initially are 4.5 m long. Determine the position of the line of action of 'W', if due to 'W', both wires extend by the same amount. [6]

$E_s = 2 \times 10^5$ N/mm^2

$E_c = 1 \times 10^5$ N/mm^2

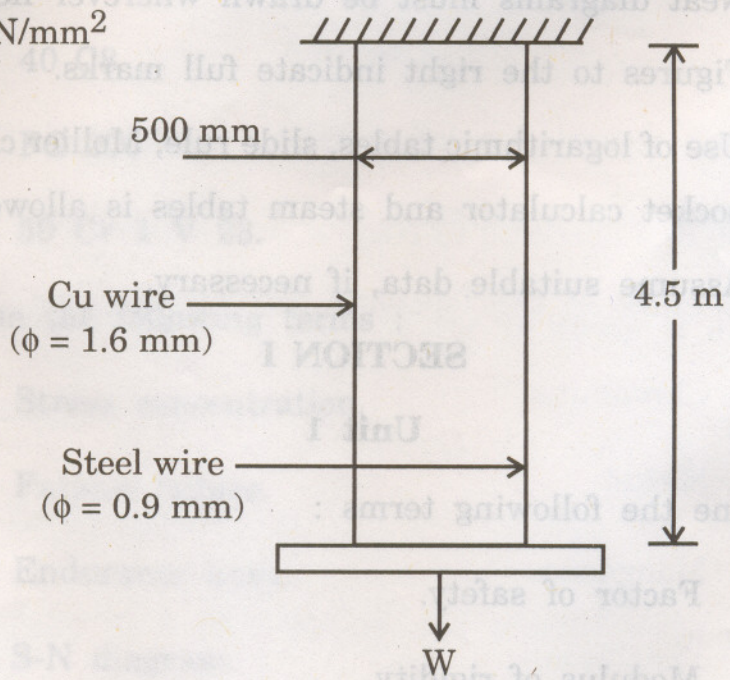

Fig. 1

(*c*) For the arrangement shown in Fig. 2 below, find maximum value of 'P' that will not exceed stress in steel of 140 MPa, in Aluminium of 90 MPa and in Bronze 100 MPa. [6]

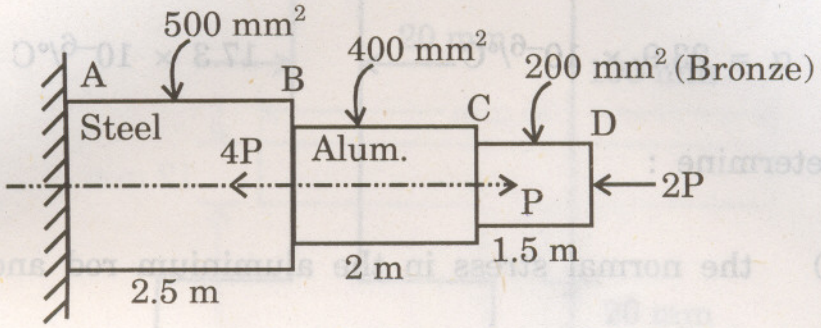

Fig. 2

Or

2. (*a*) Draw a typical stress-strain diagram for ductile material indicating all silent points. [4]

(*b*) For the arrangement shown in Fig. 3 below, 0.5 mm gap exists between the ends of the rod at 21°C.

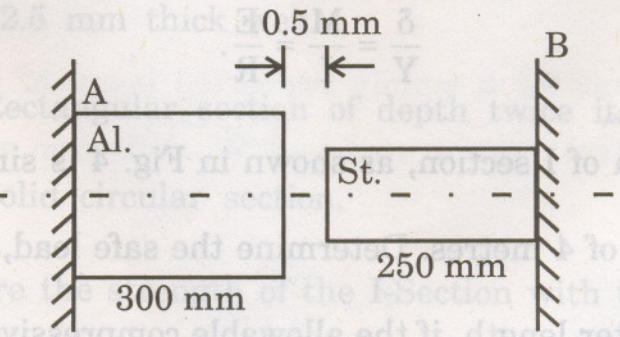

Fig. 3

	Aluminium	Steel
	$A = 1806\ mm^2$	$774\ mm^2$
	$E = 72\ GPa$	$190\ GPa$
	$\alpha = 23.9 \times 10^{-6}/°C$	$17.3 \times 10^{-6}/°C$

Determine :

(*i*) the normal stress in the aluminium rod and

(*ii*) the change in length of aluminium rod, when the temp. has reached 160°C. [6]

(*c*) Derive the expression for volumetric strain of a cylindrical rod subjected to axial force. [6]

Unit 2

3. (*a*) Derive the following relation for bending :

$$\frac{\delta}{Y} = \frac{M}{I} = \frac{E}{R}.$$ [8]

(*b*) A beam of I section, as shown in Fig. 4 is simply supported over a span of 4 metres. Determine the safe load, the beam can carry per meter length, if the allowable compressive stress in the beam is 30.82 N/mm^2. [8]

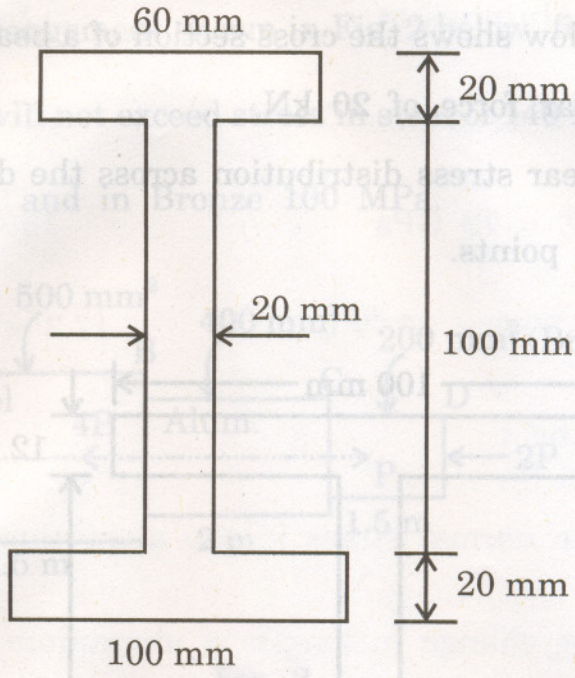

Fig. 4

Or

4. (*a*) The following three beams have the same length and are of the same material and have same weight :

(*i*) I section 400 mm × 180 mm with 20 mm thick flanges and 12.5 mm thick web.

(*ii*) Rectangular section of depth twice its width.

(*iii*) Solid circular section.

Compare the strength of the I-Section with the rectangular and circular sections. [8]

(*b*) Fig. 5 below shows the cross-section of a beam which is subjected to a shear force of 20 kN.

Draw shear stress distribution across the depth marking values at silent points. [8]

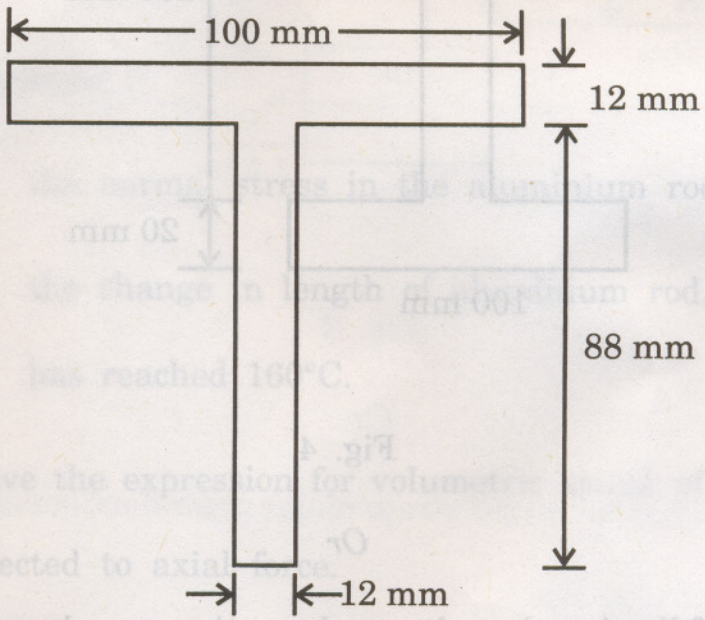

Fig. 5

Unit 3

5. (*a*) Show that for a simply supported beam of length '*l*' subjected to a central concentrated load 'W', deflection at mid-span is given by :

$$Y = \frac{Wl^3}{48\ EI}.$$

Use double integration method. [6]

(*b*) Determine the maximum deflection in the beam, shown in the following Fig. 6. Take E = 200 kN/mm^2, I = 4.79 × 10^8 mm^4. Use Macaulay's method. [12]

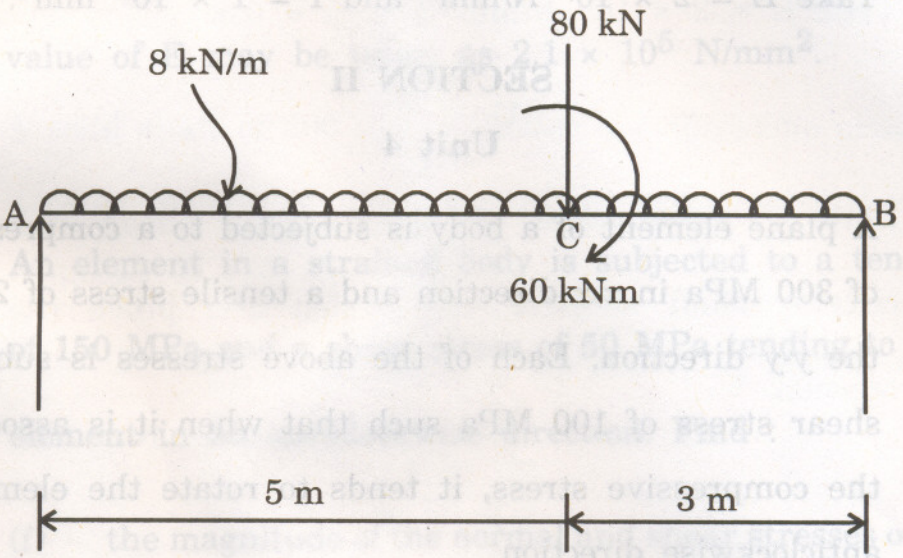

Fig. 6

Or

6. (*a*) State the theorems of 'Moment Area' method. [4]

(*b*) Give relations between 'actual beam' and 'corresponding conjugate beam' for any six different conditions. [6]

(*c*) A simply supported beam of length 4 m carries point loads of 3 kN at a distance of 1 m from each end.

Using conjugate beam method, determine :

(*i*) the slope at each end and under each load.

(*ii*) deflection under each load and at the centre.

Take E = 2×10^5 N/mm^2 and I = 1×10^8 mm^4. [8]

SECTION II

Unit 4

7. (*a*) A plane element of a body is subjected to a compressive stress of 300 MPa in *x-x* direction and a tensile stress of 200 MPa in the *y-y* direction. Each of the above stresses is subjected to a shear stress of 100 MPa such that when it is associated with the compressive stress, it tends to rotate the element in the anticlockwise direction.

Find graphically or analytically, the normal and shear stresses on a plane inclined at an angle of 30° with the *x-x* axis. [6]

(*b*) A bolt is subjected to an axial pull of 8 kN and a transverse shear force of 3 kN. Determine the diameter of the bolt based on :

(*i*) the maximum principal stress theory.

(*ii*) the maximum shear stress theory.

(*iii*) the maximum strain energy theory.

Take elastic limit in simple tension equal to 270 N/mm^2 and Poisson's ratio = 0.3. Adopt a factor of safety equal to 3. [6]

(c) A rod 12.5 mm in diameter is stretched by 3.20 mm under a steady load of 10,000 N. What stress would be produced in the bar by a weight (impact) of 700 N falling through 75 mm before commencing to stretch the rod, if it is initially unstressed. The value of E may be taken as 2.1×10^5 N/mm^2. [6]

Or

8. (a) An element in a strained body is subjected to a tensile stress of 150 MPa and a shear stress of 50 MPa tending to rotate the element in an anticlockwise direction. Find :

(i) the magnitude of the normal and shear stresses on a section inclined at 40° with the tensile stress.

(ii) the magnitude and direction of maximum shear stress that can exist on the element. [6]

(b) Show that in a bar, subjected to an axial load, the instantaneous stress due to sudden application of a load is twice the stress caused by the gradual application of load. [6]

(c) A thin cylindrical shell 2 m long has 200 mm diameter and thickness of metal 10 mm. It is filled completely with the fluid at atmospheric

pressure. If an additional 25,000 mm^3 fluid is pumped in, find the pressure developed and hoop stress developed.

Find also the changes in diameter and length.

Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$. [6]

Unit 5

9. (*a*) State 4 assumptions for determining shear stresses in a circular shaft subjected to torsion and prove the following relation : [8]

$$\frac{Z}{R} = \frac{G.\theta}{l}.$$

(*b*) A 1.5 m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking a factor of safety of 3, calculate safe load using :

(*i*) Rankine's formula.

Take $\sigma_c = 560$ N/mm^2 and $\alpha = \frac{1}{1600}$ for pinned ends.

(*ii*) Euler's formula :

Take $E = 1.2 \times 10^5$ N/mm^2 for C.I. [8]

Or

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

Explain the limitation of Euler's formula in case of slenderness ratio. [8]

(*b*) A solid shaft of 200 mm diameter has the same cross-sectional area as that of a hollow shaft of the same material with inside diameter of 150 mm.

Find the ratio of the power transmitted by the two shafts at the same speed. [8]

Unit 6

11. (*a*) Explain weighted point method for selection of engg. material for particular application. [6]

(*b*) State effect of the following alloying element in alloy steel :

(*i*) Chromium

(*ii*) Nickel

(*iii*) Manganese

(*iv*) Vanadium. [4]

(*c*) Define creep. Draw a typical creep curve and explain 3 stages of the creep. [6]

Or

12. (*a*) Suggest suitable material for the following application giving reasons :

(*i*) Condenser tubes

(*ii*) Valve spring

(*iii*) IC engine piston

(*iv*) Worm wheel. [8]

(*b*) What do you understand by the following designation of material ?

(*i*) SG 700/2

(*ii*) 40 C8

(*iii*) FG 200

(*iv*) 50 Cr 1 V 23. [4]

(*c*) Define the following terms :

(*i*) Stress concentration.

(*ii*) Fatigue failure.

(*iii*) Endurance limit.

(*iv*) S-N diagram. [4]

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

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S.E. (Mech.) (Sem. I) EXAMINATION, 2008

FLUID MECHANICS

(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 Newton's law of Viscosity. Convert 1 kg/sm dynamic viscosity in Poise. [5]

(*b*) Hydrogen is to be fill in balloon at a ground level so that this balloon is to expand to a sphere 20 m diameter at a height of 30 km with the stress in the fabric in balloon. Absolute pressure at 30 km height is 1100 Pa and temperature

P.T.O.

–38°C if the absolute pressure at a ground level is 100 kPa and temperature 15°C. Find the volume of hydrogen to be fill. [4]

(*c*) Derive continiuty equation

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

with usual notations. [7]

Or

2. (*a*) The velocity components in two dimensional irrotational flow of an incompressible fluid are

$$u = \frac{y^3}{3} + 2x - x^2 y \text{ and}$$

$$v = xy^2 - 2y - \frac{x^3}{3}.$$

(*i*) Is the flow possible ?

(*ii*) Is the flow rotational or irrotational ?

(*iii*) Determine stream function.

(*iv*) Determine velocity potential function. [6]

(*b*) The gap between rotating circular disk and a parallel plane fix surface is 1 mm. The gap is filled with a fluid of viscosity 1Ns/m^2. The diameter of disc is 10 cm. Find the torque that should be exerted so that it can rotate at a constant speed of 70 rpm. [6]

(*c*) Define the following properties of fluid with S.I. units.

(*i*) Density

(*ii*) Weight density

(*iii*) Specific volume

(*iv*) Specific gravity of fluid. [4]

3. (*a*) Write a short note on micromanometer. [4]

(*b*) A block of wood of sp. gravity 0.7 floats in water. Determine the metacentric height of the block if its size is 2 m × 1 m × 0.8 m and 2 m × 1 m is parallel to water surface. [6]

(*c*) Derive an expression for total pressure and centre of pressure on an inclined plane surface. [6]

Or

4. (*a*) Explain the term "Metacentre" of a floating body. Derive an expression for the distance between the metacentre and the centre of buoyancy of a floating body. [6]

(*b*) An opening 1 m wide and 2m high in the wall of a Dam is closed by a gate of the same size hinged at centre water level in the tank is 13 m above the hinge and the gate is held in position by a force F applied at its botton edge. Find 'F'.

If the flat gate is replaced by a semi-cylindrical one, as shown in Fig. (*b*) and (*c*). Find the change in force F to be applied

at the botton edge, to keep the gate in position. (Ref. Fig. 1) [10]

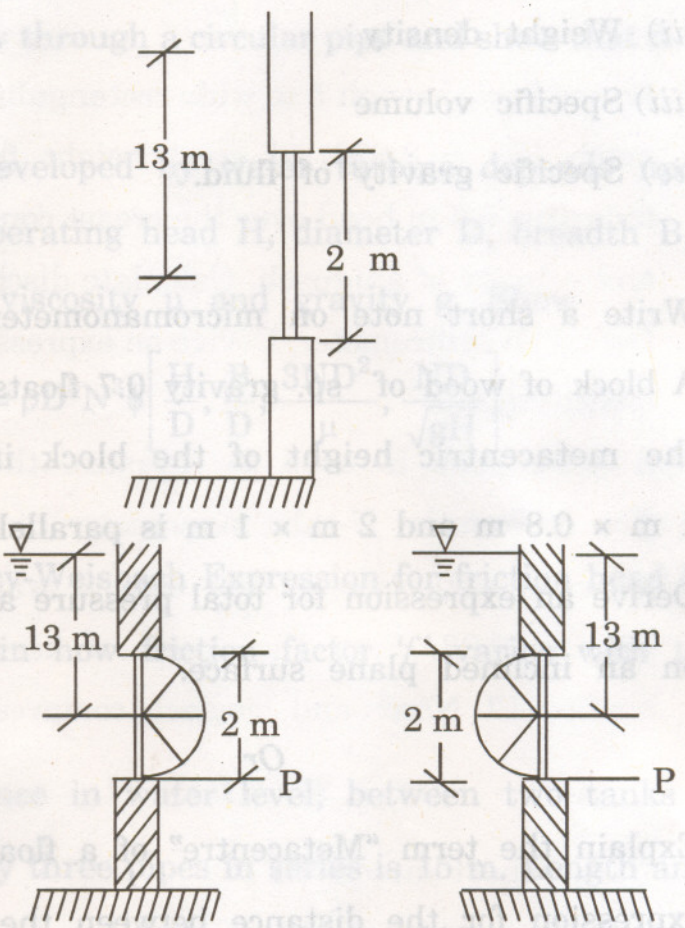

Fig. 1

5. (*a*) Derive Euler equation of motion for one dimensional flow along stream line. State clearly assumptions made and derive Bernaulli's Equation. [6]

(*b*) A venturimeter, fitted in horizontal 150 mm diameter pipeline, measures the flow of water which is 50 lps. The pressure head at inlet for this flow is 15 m above atmosphere. Between inlet and throat there is an estimated friction loss of 10% of the pressure head difference between these two points. If the separation occurs at 2.3 m of water absolute.Calculate the minimum diameter of the throat of the meter. [6]

(c) Write a short note on flowmeter. [6]

Or

6. (a) Water flow through 5 m wide rectangular channel. A rectangular notch (C_d = 0.622) of crest height 0.6 m and width 2.5 m indicates 0.6 m head over the creast considering end contractions and velocity of approach. Calculate discharge. Take two trial. [6]

(b) Define an orificemeter. Derive an expression for discharge through orifice meter. [6]

(c) A pitot tube is used to measure the velocity of aeroplane. The differential U-tube manometer connected to the pitot tube shows a deflection of 100 mm of water. If the coefficient of tube is 0.98. Find the speed of aeroplane. Take sp. wt. of air as 12 N/m^3 and neglect compressibility effect. [6]

SECTION II

7. (a) Write short notes on :

(*i*) Mach number

(*ii*) Froude number

(*iii*) Euler number

(*iv*) Reynolds number. [8]

(b) A viscous liquid of R.D. 0.9 and kinematic viscosity 2.9 × 10^{-4} m^2/s flows through a horizontal pipe 100 mm diameter. Velocity along the axis is 1.85 m/s. Find

(*i*) Shear stress along the pipe surface in Pascal.

(*ii*) Discharge in lps.

(*iii*) Power required per km of length of pipe in kJ/s.

(*iv*) Whether flow is laminar or not. [8]

Or

8. (*a*) Derive an expression for velocity distribution in fully developed laminar flow through a circular pipe and show that it is parabolic in nature. [8]

(*b*) Power P developed by water turbine depends upon rotation speed N, operating head H, diameter D, breadth B, of runner density ρ, viscosity μ and gravity g. Show

$$P = \rho D^5 N^3 \phi \left[\frac{H}{D}, \frac{B}{D}, \frac{3ND^2}{\mu}, \frac{ND}{\sqrt{gH}} \right].$$ [8]

9. (*a*) Derive Darcy-Weisbach Expression for friction head loss in pipe flow. Explain how friction factor '*f*' varies with the type of flow. [8]

(*b*) The difference in water level, between two tanks which are connected by three pipes in series is 15 m. Length and diameter of these pipes are 300 m, 150 m, 200 m and 30 cm, 20 cm and 30 cm respectively. Find the discharge through the pipeline and tabulate all losses if *f* for the three pipes to be taken as 0.02, 0.025 and 0.03. [8]

Or

10. (*a*) Explain the concept of "Equivalent Pipe" and derive Dupits equation in the following form

$$\frac{L}{D^5} = \frac{L_1}{D_1^5} + \frac{L_2}{D_2^5} + \frac{L_3}{D_3^5} + \ldots\ldots$$ [4]

(*b*) Pipe AB, L_3 = 100 m, d_3 = 300 mm, f_3 = 0.01

BC(1), L_1 = 60 m, d_1 = 150 mm, f_1 = 0.015

BC(2), L_2 = 100 m, d_2 = 200 mm, f_2 = 0.015

CD, L_4 = 150 m, d_4 = 400 mm, f_4 = 0.01

The water flow is caused by a pump developing 10 bar (G) pressure at 'A'. The discharge at 'D' is at 2.5 bar (Abs) and the pipe network is laid on a horizontal plane.

Calculate the flow rate through each section of the network and the reading of a pressure gauge at 'B' and 'C'. Take $P_{atm.}$ = 1 bar(Abs) and neglect minor cones. (Ref. Fig. 2) [12]

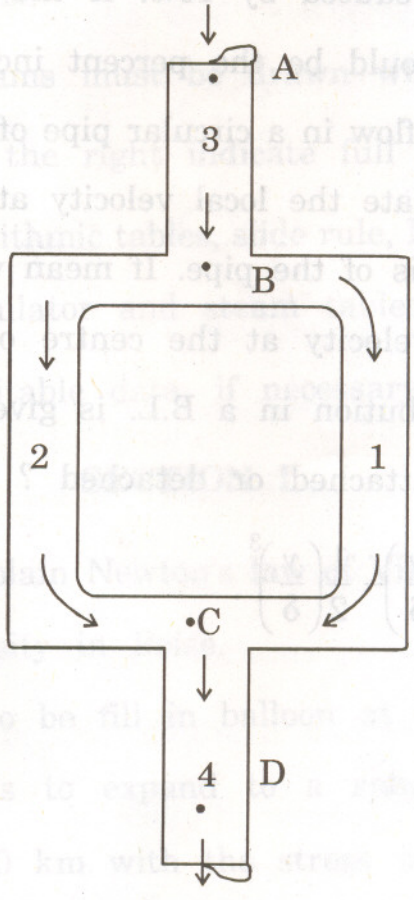

Fig. 2

11. (*a*) Distinguish between the following :

(*i*) Friction Drag and Pressure drag

(*ii*) Bluff Body and streamlined body

(*iii*) Boundary layer in laminar and Turbulent flow. [9]

(*b*) Explain the concept of boundary layer and also define the displacement thickness, nominal thickness and momentum thickness. [9]

Or

12. (*a*) After polishing the hull of a boat it was noticed that coefficient of drag has reduced by 10%. If the same driving power is used, what would be the percent increase in the speed. [6]

(*b*) For turbulent flow in a circular pipe of radius '*r*' friction factor is 0.02. Estimate the local velocity at a radial distance 0.25 *r* from the axis of the pipe. If mean velocity is 0.3 m/s what will be the velocity at the centre of the pipe. [6]

(*c*) Velocity distribution in a B.L. is given below. Find whether the flow is attached or detached ?

$$\frac{U}{U_\infty} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3.$$ [6]

Total No. of Questions—12] [Total No. of Printed Pages—8+1

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S.E. (Mechanical) EXAMINATION, 2008

Common to Mechanical Sand./Prod./ Prod. Sand./Industrial Engg./Metarlgy

ENGINEERING MATHEMATICS—III

(2003 COURSE)

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

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

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

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

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

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

SECTION I

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

(*i*) $\frac{d^4y}{dx^4} + y = \cos x \cosh x$

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

(*iii*) $\frac{d^2y}{dx^2} - y = \left(1 + e^{-x}\right)^{-2}$ (by variation of parameters)

(*iv*) $x^2 \frac{d^2y}{dx^2} - 4x \frac{dy}{dx} + 6y = x^5$

(*v*) $\frac{d^2y}{dx^2} + 5 \frac{dy}{dx} + 6y = e^{-2x} \sec^2 x \,(1 + 2 \tan x)$.

P.T.O.

(*b*) Solve :

$$\frac{dx}{dt} - 3x - 6y = t^2$$

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

Or

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

(*i*) $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 13y = 8e^{3x} \sin 4x + 2x$

(*ii*) $\frac{d^2y}{dx^2} + 4y = x \sin^2 x$

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

(*iv*) $(2x + 3)^2 \frac{d^2y}{dx^2} - 2(2x + 3)\frac{dy}{dx} - 12y = 6x$

(*v*) $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = e^{e^x} + \cos e^x.$

(*b*) Solve :

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

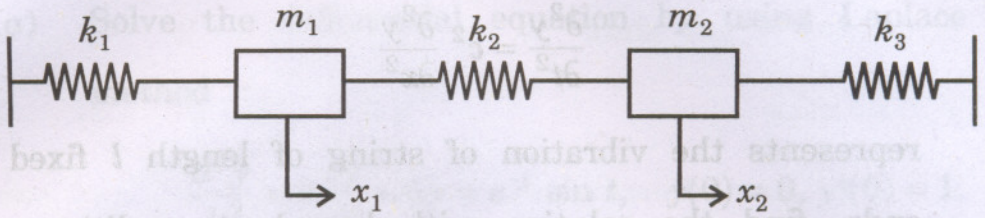
3. (*a*) A homogeneous conducting rod of length 100 c.m. has its ends kept at zero temperature, initially the temperature of the rod is

$u(x, 0) = x \qquad 0 \le x \le 50$

$= 100 - x \qquad 50 \le x \le 100.$

Find the temperature $u(x, t)$ at any time. [9]

(*b*) For the system as shown in the following figure :



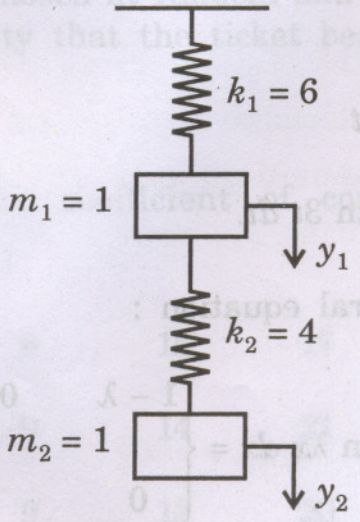
if

$$m_1 = 1,\ m_2 = 3,\ k_1 = 1,\ k_2 = 3,\ k_3 = 3;$$

assuming that there is no friction find the natural frequencies of the system and corresponding normal modes of vibration using matrix method. [8]

Or

4. (*a*) The system shown in the following figure begins to move with initial displacements $Y_0 = \begin{bmatrix} 1 \\ \\ 2 \end{bmatrix}$ and initial velocities $\dot{Y}_0 = \begin{bmatrix} 2 \\ \\ -1 \end{bmatrix}$ assuming that there is no friction in the system determine its subsequent motion. [8]



(*b*) If

$$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$$

represents the vibration of string of length l fixed at both ends, find the solution with boundary conditions :

(*i*) $y(0, t) = 0$

(*ii*) $y(l, t) = 0$

and initial conditions :

(*iii*) $\left(\frac{\partial y}{\partial t}\right)_{t=0} = 0$

(*iv*) $y(x, 0) = K\left(lx - x^2\right), 0 \leq x \leq l.$ [9]

5. (*a*) Find Fourier sine transform of $\frac{e^{-ax}}{x}$. [5]

(*b*) Find Laplace transform of any *two* of the following :

(*i*) $\frac{1 - \cos t}{t}$

(*ii*) $t\, e^{-t} \sin^3 t$

(*iii*) $e^{-4t} \int_0^t t \sin 3t \, dt.$ [6]

(*c*) Solve the integral equation :

$$\int_0^\infty f(x) \sin \lambda x \, dx = \begin{cases} 1 - \lambda & 0 \leq \lambda \leq 1 \\ 0 & \lambda \geq 1. \end{cases}$$ [5]

Or

6. (*a*) Solve the differential equation by using Laplace transform method :

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = e^{-t} \sin t, \quad y(0) = 0, y'(0) = 1. \qquad [5]$$

(*b*) Use Convolution theorem to find inverse Laplace transform of

$$\frac{1}{(s-2)^4 (s+3)}. \qquad [5]$$

(*c*) Using Fourier integral representation, show that :

$$\int_0^\infty \frac{\lambda^3 \sin \lambda x}{\lambda^4 + 4} d\lambda = \frac{\pi}{2} e^{-x} \cos x$$

where $x > 0$. [6]

SECTION II

7. (*a*) An envelope contains 6 tickets with numbers 1, 2, 3, 5, 6, 7. Another envelope contains 4 tickets with numbers 1, 3, 5, 7. An envelope is chosen at random and ticket is drawn from it. Find the probability that the ticket bears the numbers :

(*i*) 2 or 5

(*ii*) 2. [4]

(*b*) Calculate the coefficient of correlation for the following distribution : [6]

x	5	9	15	17	24	28	32
y	7	9	14	21	23	29	30
f	6	9	13	20	16	11	7

(*c*) The accidents per shift in a factory are given by the table :

Accidents 'x' per shift :	0	1	2	3	4	5
'f' frequency :	142	158	67	27	5	1

Fit a Poisson distribution to the above table and calculate theoretical frequencies. [6]

Or

8. (*a*) 'A' is one of the eight horses entered for a race and is to be ridden by one of the two jockeys B and C. It is 2 to 1 that B rides A, in which case all the horses are equally likely to win whereas, with rider C A's chance is doubled.

(*i*) Find the probability that A wins.

(*ii*) What are odds against A's winning ? [4]

(*b*) Obtain the regression lines for the following data : [6]

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

(*c*) Assuming that the diameters 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 ?

Given :

Area $A_1 = 0.4878$ for $z_1 = 2.25$

$A_2 = 0.4599$ for $z_2 = -1.75$. [6]

9. (*a*) If

$$\bar{r} \times \frac{d\bar{r}}{dt} = 0,$$

show that $\bar{r}$ has a constant direction. [5]

(*b*) Prove the following (any *two*) :

(*i*) $\nabla \times \left(\frac{\bar{a} \times \bar{r}}{r^3} \right) = - \frac{\bar{a}}{r^3} + \frac{3(\bar{a} \cdot \bar{r})}{r^5} \bar{r}$

(*ii*) $\nabla^4 e^r = e^r + \frac{4}{r} e^r$

(*iii*) $\nabla^2 \left(r^n \log r \right) = \left[n (n+1) \log r + 2n + 1 \right] r^{n-2}$. [6]

(*c*) Show that :

$$\bar{F} = \left(6xy + z^3 \right) \bar{i} + \left(3x^2 - z \right) \bar{j} + \left(3xz^2 - y \right) \bar{k}$$

is irrotational. Hence find the scalar ϕ such that $\bar{F} = \nabla\phi$. [5]

Or

10. (*a*) If the directional derivative of $\phi = ax^2y + by^2z + cz^2x$ at (1, 1, 1) has maximum magnitude 15 in the direction parallel to

$$\frac{x-1}{2} = \frac{y-3}{-2} = \frac{z}{1},$$

hence find the values of *a*, *b*, *c*. [6]

(*b*) Determine $f(r)$ such that the field $\overline{F} = f(r)\,\bar{r}$ is solenoidal. Also find $f(r)$ such that $\nabla^2 f(r) = 0$. [5]

(*c*) Prove that :

$$\bar{a} \cdot \nabla\left[\bar{b} \cdot \nabla\left(\frac{1}{r}\right)\right] = \frac{3(\bar{a} \cdot \bar{r})(\bar{b} \cdot \bar{r})}{r^5} - \frac{\bar{a} \cdot \bar{b}}{r^3}.$$ [5]

11. (*a*) 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 :

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

Is the field conservative ? [6]

(*b*) Evaluate :

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

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

(*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. [6]

Or

12. (*a*) Evaluate :

$$\iint (\nabla \times \overline{F}) \, . \, d\overline{S}$$

where

$$\overline{F} = \left(x^3 - y^3\right) \bar{i} - xyz \; \bar{j} + y^3 \; \bar{k}$$

and S is the surface $x^2 + 4y^2 + z^2 - 2x = 4$ above the plane $x = 0$. [6]

(*b*) Evaluate :

$$\iint_S \left(x^3 \; \bar{i} + y^3 \; \bar{j} + z^3 \; \bar{k}\right) . d\overline{S},$$

where S is the surface of the sphere $x^2 + y^2 + z^2 = 16$. [7]

(*c*) Show that the motion of an incompressible perfect fluid is a possible motion when the velocity $\overline{q}$ is given by :

$$\overline{q} = x\left(y^2 - z^2\right) \bar{i} + y\left(z^2 - x^2\right) \bar{j} + z\left(x^2 - y^2\right) \bar{k}$$

Find whether motion is irrotational or not. [5]

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

[3462]-115

S.E. (Mech.) (First Semester) EXAMINATION, 2008

MANUFACTURING PROCESSES—I

(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*) *All* questions carry equal marks.

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

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

SECTION I

1. (*a*) State the principles of centrifugal casting and state its advantages and limitations. [6]

(*b*) Explain in brief various allowances provided on pattern. [5]

(*c*) Write the procedure for moisture content test for moulding sand. [5]

P.T.O.

Or

2. (*a*) Explain transfer moulding with sketch. [6]

(*b*) Describe the hot chamber die casting. [5]

(*c*) Explain in brief shell moulding processes. [5]

3. (*a*) Explain in brief drop forging technique. How does this technique vary from press forging technique ? [6]

(*b*) Describe the operation of tube drawing. [5]

(*c*) Describe different types of rolling mills. [5]

Or

4. (*a*) What is meant by 'Cold-working Processes' ? List different cold-working processes along with their applications. [6]

(*b*) Explain the following processes : [10]

(*i*) Forward extrusion;

(*ii*) HERF.

5. (*a*) Explain the principles of resistance welding. [6]

(*b*) Explain the different types of flames used in gas welding with application of each flame. [6]

(*c*) Compare AC arc welding and DC arc welding. [6]

Or

6. (*a*) Describe various types of adhesives and their applications. [6]

(*b*) Explain the process of soldering and brazing. [6]

(*c*) Describe plasma welding process and state its application. [6]

SECTION II

7. (*a*) Sketch the management of the guideways on the bed of a centre lathe and state the purpose of each. [4]

(*b*) State and explain the different methods of picking up a thread. [4]

(*c*) On what parts of a lathe the following are mounted ? [4]

(*i*) Face plate

(*ii*) Dead centre

(*iii*) Compound rest

(*iv*) Follower rest.

(*d*) Write down details of tool signatures specified as 10—14—6—6—6—15—1

Show it on three views of single point cutting tool. [4]

Or

8. (*a*) Describe in detail, how the set over method for taper turning is used on a lathe ? [4]

(*b*) Compare of three-jaw chuck and four-jaw chuck with its advantages and limitations. [4]

(*c*) Find the time required for one complete cut on a piece of work 300 mm long and 60 mm in diameter. The cutting speed is 28 metres/minute and feed is 0.05 mm/revolution. [4]

(*d*) Sketch back geared headstock, label the parts. [4]

9. (*a*) Name the type of cutter best suited to producing large diameter holes in sheet metal. How does it function ? [4]

(*b*) Draw a neat sketch of sensitive drilling machine. Show the following elements on it : [4]

(*i*) Drill spindle

(*ii*) Quill

(*iii*) Motor

(*iv*) Stepped pulley.

(*c*) Find out gear train and indexing movement for cutting 97 teeth on a spur gear blank by differential indexing method.

Set of gears : 24, 24, 28, 32, 40, 44, 48, 56, 64, 72, 86 and 100 with special gear of 84 teeth. [4]

(*d*) Write short notes on :

(*i*) Cam milling;

(*ii*) Milling Arbor. [4]

Or

10. (*a*) Is it important that the lip length of a drill point are equal ? Comment with sketch. [4]

(*b*) Give constructional and operational features of a quick change chuck. [4]

(*c*) State in what respect the universal milling machine differs from plain milling machine. [4]

(*d*) Sketch and state the applications of the following milling cutters : [4]

(*i*) Slitting cutter

(*ii*) Shell end mill.

11. (*a*) Classify the grinding machines. Explain with sketch "Swing Frame Grinder". Where is it used ? [4]

(*b*) Differentiate between the : [6]

Vitrified Bond *Vs.* Silicate Bond

Grain size *Vs.* Grade.

(*c*) Draw a sketch of a hone. Explain its working and applications. [4]

(*d*) Explain the principle of superfinishing operation. [4]

Or

12. (*a*) Describe various types of surface grinders with simple sketches. [4]

(*b*) What is centreless grinding ? Describe centreless grinding operations. [4]

(*c*) Explain how burnishing is carried out ? [4]

(*d*) Sketch geometrical conditions corrected by honing. State its applications. [6]