Roll No. ..... Total Pages : 3

8451

BT-4/M-12

PRODUCTION TECHNOLOGY-II

W.e.f. 2006 onwards

Paper–ME-202E

Time Allowed : 3 Hours] [Maximum Marks : 100

Note : Attempt any **five** questions, selecting at least **one** question from each Unit.

UNIT–I

1. (a) Differentiate between Individual and Group Drives. 8

   (b) What is the principle of Stepped regulation ? List some layouts of spindle speeds and give their advantages and disadvantages. 12

2. (a) How will you ascertain requisite number of steps in a given speed range ? 10

   (b) Give a general procedure to design an all geared head stock. 10

UNIT–II

3. (a) Differentiate between Capstan and Turret Lathe. 6

   (b) Describe the complete working of a turret-indexing mechanism with the help of a line diagram. 14

4. (a) Describe gear shaping process with the help of a heat diagram. 10

   (b) Discuss some suitable gear finishing methods for hardened gears. 10

UNIT–III

5. What is Electrochemical Machining ? Describe the mechanism of metal removal and derive suitable expression for material removal rate. 20

6. (a) Describe Shear action in Die cutting operations and highlight the importance of Clearances in Press working. 8

   (b) How will you calculate Centre of Pressure for a non-symmetrical punch ? 12

UNIT–IV

7. (a) What is Machine Tool Chatter ? List and discuss various sources of Vibration. 10

   (b) What are the basic design requirements of Dynamometers ? 10

8. Write notes on the following :

   (a) Drill Dynamometers. 10

   (b) Turning Dynamometers. 10

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8459

BT-4/M-12

MATHEMATICS–III

Paper–MATH-201-E

Time Allowed : 3 Hours] [Maximum Marks : 100

Note : Attempt **five** questions in **all**, selecting at least **one** question from each Unit. All questions carry equal marks.

UNIT–I

1. (a) Obtain a Fourier series to represent $f(x) = \left(\frac{\pi - x}{2}\right)^2$ in the range 0 to 2π.

   (b) If $f(x) = x,\ 0 < x < \pi/2$

   $\pi - x,\ \pi/2 < x < \pi,$

   expand f(x) in a half range cosine series.

2. (a) Find the Fourier transform of

$$f(x) = e^{-x^2/2},\ -\infty < x < \infty.$$

(b) Obtain Fourier sine transform of

$$f(x) = \begin{cases} x, & 0<x<1 \\ 2-x, & 1<x<2, \\ 0, & x>2 \end{cases}$$

UNIT–II

3. (a) Separate $\cos^{-1}(\cos\theta + i\sin\theta)$ into real and imaginary parts, where θ is a positive acute angle.

   (b) Determine the analytic function, whose real part is $4 = y + e^x \cos y$.

4. (a) If f(z) is an analytic function with constant modulus, show that f(z) is constant.

   (b) Determine the region of the w-plane into which the region bounded by $x = 1$, $y = 1$, $x + y = 1$ is mapped by the transformation $w = z^2$.

UNIT–III

5. (a) A speaks the truth in 75% cases and B in 80% of the cases. In what percentage of cases, are they likely to contradict each other in stating the same fact ?

   (b) The contents of three urns are 1 white, 2 red, 3 green balls; 2 white, 1 red, 1 green balls and 4 white, 5 red, 3 green balls. Two balls are drawn from an urn chosen at random. These are found to be one white and one green. Find the probability that the balls so drawn came from the third urn.

6. (a) A source of liquid is known to contain bacteria with the mean number of bacteria per cubic centimetre equal to 3. Ten I.C.C. test tubes are filled with the liquid. Assuming that Poisson distribution is aplicable, calculate the probability that all the test tubes will show growth i.e. contain at least one bacterium each.

   (b) The mean and standard deviation of the marks obtained by 1,000 students in an examination are 34.4 and 16.5 respectively. Assuming the normality of the distribution, find the approximate number of students expected to obtain marks between 30 and 60.

UNIT–IV

7. (a) Using graphical method, solve the following L.P. problem :

Maximize $Z = 100x_1 + 40x_2$

Subject to

$$10x_1 + 4x_2 \le 2000$$
$$3x_1 + 2x_2 \le 900$$
$$6x_1 + 12x_2 \le 3000$$
$$x_1, x_2 \ge 0.$$

   (b) Convert the following L.P.P. to standard form :

Maximize $Z = 3x_1 - 2x_2 + 4x_3$

Subject to

$$x_1 + 2x_2 + x_3 \le 8$$
$$2x_1 - x_2 + x_3 \ge 2$$
$$4x_1 - 2x_2 - 3x_3 = -6$$
$$x_1, x_2 \ge 0.$$

Roll No. ..... Total Pages : 3

8453

BT-4/M-12

STRENGTH OF MATERIALS–II

(Will 2006 Onwards)

Paper–ME-206-E

Time Allowed : 3 Hours] [Maximum Marks : 100

Note : Attempt **five** questions in all, selecting at least one question from each Section. Each question carries equal marks.

SECTION–I

1. The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Estimate the diameter of the bolt required according to different theories of elastic failure. The elastic limit in simple tension is 270 N/mm² and a factor of safety of 3 is to be applied. Take Poisson's ratio as 0.3. 20

2. A simply supported beam of span 3 m is carrying a concentrated load of 15 kN at the mid span. Determine the strain energy stored in the beam due to horizontal shear. The beam is 8 cm wide and 10 cm deep. E = 200 GPa and Poisson's ratio = 0.3. 20

SECTION–II

3. A boiler drum consists of a cylindrical portion 2 m long, 1-m diameter and 25 mm thick, closed by hemispherical ends. In a hydraulic test ratio 10 N/mm² how much additional water will be pumped in, after initial filling at atmospheric pressure ? Assume the circumferential strain at the junction of cylinder and hemisphere is same for the both. For the drum material, E = 207,000 N/mm²; Poisson's ratio = 0.3. For water K = 2100 N/mm². 20

4. A 5 cm × 3 cm × 0.5 cm angle is used as a cantilever of length 5 cm with the 3 cm leg horizontal. A load of 1000 N is applied at the free end. Determine the position of the neutral axis and the maximum stress set up. 20

SECTION–III

5. Two thick steel cylinders A and B closed at the ends, have the same dimensions, the outside diameter being 1.6 times the inside. A is subjected to internal pressure only and B to external pressure only. Find the ratio of these pressures (1) when the greatest circumferential stress has the same numerical value and (2) when the greatest circumferential strain has the same numerical value. The Poisson's ratio is 0.304. 20

6. Determine the greatest value of radial and hoop stress for a rotating disc in which the outer and inner radii are 30 cm and 150 cm. Speed (w) = 150 rad./sec; Poisson's ratio = 0.304, Density = 7700 kg/m³. 20

SECTION–IV

7. Discuss the stresses in open coil helical spring subjected to twisting moment. A semielliptical leaf spring 1 m long has 2 leaves of full length and 7 graduated leaves. The spring is to carry a maximum load of 5.4 kN. Taking allowable stress as 490 N/mm², calculate the width and thickness of leaves, if deflection is not to exceed 7.5 cm, when (a) all leaves are equally stressed and (b) leaves have no initial tension. Take E = 200 GPa. 20

8. A crane hook whose horizontal cross section is trapezoidal is used to support a load of 2,000 kg at the point of maximum bending moment. The trapezoidal section has parallel sides of 4 cm and 1 cm and depth of 7 cm, internal radius of curvature is 3 cm. Calculate the maximum stresses on the section. 20

Roll No. ..... Total Pages : 3

8452

BT-4/M-12

MATERIAL SCIENCE

Paper–ME-204-E

Time Allowed : 3 Hours] [Maximum Marks : 100

Note : Attempt only **five** questions, selecting one question from each Unit.

UNIT–I

1. (a) Calculate the Ionic packing fraction of NaCl having FCC structure. The Ionic radii of Sodium and Chlorine are 0.98Å and 1.81 Å respectively. 8

   (b) Determine the coordination number for

   (i) BCT

   (ii) ECO

   (iii) SR

   (iv) ECM unit cells. 12

2. (a) Explain the following in brief :

   (i) Frankel & Schottky defects.

   (ii) High & Low Angle Boundary defects. 12

   (b) Discuss the various effects of imperfections on metal properties. 8

UNIT–II

3. (a) Explain the Iron-Carbon equilibrium diagram with the help of all salient features. 10

   (b) Discuss the importance of Lever rule. Which information of a Phase-diagram can be known from the idea of Lever rule. 10

4. (a) Explain the importance of Grain-Growth phenomenon. 10

   (b) Discuss the following Heat treatment process in brief :

   (i) Carburizing

   (ii) Normalizing. 10

UNIT–III

5. (a) Explain the mechanism of Plastic deformation in brief. 10

   (b) Why does yielding occur in the ductile materials ? How does it influence the behaviour of metal ? 10

6. (a) Discuss the limitations of Griffith's theory of brittle feacture. Also state its salient features. 10

   (b) Compare linearly elastic and non-linearly elastic materials. State the situations when a designer should adopt secant modulus and tangent modulus. 10

UNIT–IV

7. (a) Compare the damping capacity of grey cast iron with bronze mild-steel and plastics. Suggest a suitable material for making machine tool beds. Also justify your answer. 10

   (b) Discuss the mechanism and effect of Corrosion process. Also suggest some examples of Corrosion associated with mechanical deformation. 10

8. (a) Explain the mechanical behaviour of Plastics. Discuss their properties and applications. 10

   (b) Discuss the various methods of Ceramics processing in brief. Also mention their salient features. 10

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Total Pages : 4

8455

BT-4/M-12

DYNAMICS OF MACHINES

Paper–MET-210-E

Time Allowed : 3 Hours] [Maximum Marks : 100

Note : Attempt **five** questions in all, selecting at least **one** question from each Unit.

UNIT–I

1. In Fig. 1 a riveter mechanism is shown. Determine the magnitude of force S as applied on slider 2 :
AB = 34 cm, EF = 36 cm, CB = 23 cm, FG = 23 cm, CD = 23.5 cm, BF = 35 cm, EH = 53 cm, CE = 24 cm.

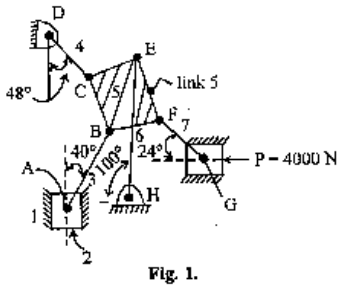

Fig. 1.

2. In a four bar linkage ABCD shown in Fig. 2, the link AB revolves with angular velocity of 20 rad/s and angular acceleration of 100 rad/sec^2 both in clockwise direction when it makes an angle 45° with AD. Neglecting gravitational effects, find the torque necessary to overcome inertia forces. The length of various links are :

AB = CD = 40 cm.

BC = 50 cm, AD = 75 cm.

The mass of links is 15 kg/m.

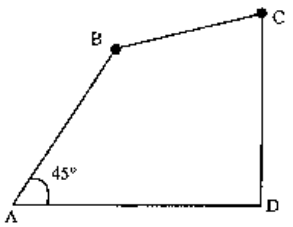

Fig. 2

UNIT–II

3. (a) What is difference between involute and cycloidal gears ? 8

(b) Derive suitable mathematical expression for minimum number of teeth on pinion to avoid interference. 12

4. In an epicyclic gear train as shown in Fig. 3, the driving wheel A has 14 teeth and the fixed annular wheel C 100 teeth, the ratio of tooth numbers in wheels E and D is 98 : 41. If 2.5 H.P. at 1200 r.p.m. is supplied to wheel A, find the speed and direction of E and fixing torque required at C.

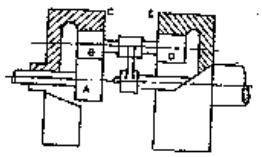

Fig. 3

UNIT–III

5. A shaft carries four masses in parallel planes A, B, C and D in order along a shift. The masses at B and C are 18kg and 12.5 kg respectively and each has an eccentricity of 6 cm. The masses at A and D have an eccentricity of 8 cm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190° both the angles measured in the same sense. The axial distance between the planes A and B is 10 cm and between B and C is 20 cm. If the shaft is in complete dynamic balance determine :

(i) the weight of masses at A and D.

(ii) the distance between planes C and D.

6. In a governor of the type shown in Fig. 4, the two springs attached directly to balls each has a stiffness of 8 N/cm and a free length of 10 cm. The mass of each ball is 4 kg, the length of the ball arm of each bell crank lever is 8 cm and that of the sleeve arm is 6 cm, the lever is pivoted at its mid-point. When the radius of rotation of the ball is 8 cm, the equilibrium speed is 240 r.p.m. If the sleeve is to lift 0.75 cm for an increase of speed of 5%, determine the required stiffness of the auxiliary spring.

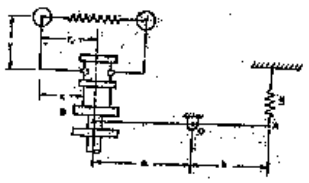

Fig. 4

UNIT–IV

7. One of the driving axles of a locomotive with its two wheels has a moment of inertia of 350 kg-m^2. The wheels are of 1.85 m diameter. The distance between the planes of wheels is 1.5 m. When travelling at 100 km/hr the locomotive passes over a defective rail which causes the right hand wheel to fall 12 mm and rise again in a total time of 0.1 sec., the vertical movement of the wheel being S.H.M. Find the maximum gyroscopic couple.

8. Explain the relationship between open loop and close loop transfer function.

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8454

BT-4/M-12

FLUID MECHANICS

w.e.f. (2006 on words)

Paper–ME-208-E

Option–II

Time Allowed : 3 Hours] [Maximum Marks : 100

Note : Attempt **five** questions in all, selecting at least **one** question from each Unit.

UNIT–I

1. (a) Derive expressions for total pressure and centre of pressure for a vertically immersed surface. 10

   (b) State and prove Pascal's law and give some examples where this principle is applied. 6

   (c) Define compressibility and bulk modules of a fluid. 4

2. (a) In a two dimensional compressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form as well as stream function. 8

   (b) Distinguish between pathlines, streamlines and streak lines. 6

   (c) Differentiate between following :

   (i) Rotational and Irrotational flow.

   (ii) Circulation and Vorticity. 6

UNIT–II

3. (a) Determine the rate of flow of water through a pipe 300 mm diameter placed in an inclined position where a venturimeter is inserted, having a throat diameter of 150 mm. The difference of pressure between the main and throat is measured by a liquid of sp. gravity 0.7 in an inverted U-tube which gives a reading of 260 mm. The loss of head between the main and throat is 0.3 times the Kinetic head of the pipe. 10

   (b) Why is coefficient of discharge of an orificemeter much smaller than that of venturimeter ? 4

   (c) What is Pilot tube ? How it is used to measure the velocity of flow at any point in a pipe or channel ? 6

4. (a) Differentiate between Forced vortex and Free vortex flow. 4

   (b) The velocity distribution for turbulent flow in a pipe is given approximately by Prandtl's one-seventh power law, $u = u_m \left[\frac{y}{r_0}\right]^{1/7}$, where u is the local velocity of

flow at a distance 'y' from the pipe wall, Um is the maximum velocity at the centreline of the pipe and r_0 is the pipe radius. Find :

   (i) Average velocity

   (ii) Kinetic energy correction factor

   (iii) Momentum correction factor. 16

UNIT–III

5. (a) Derive an expression for the velocity distribution for viscous flow through a circular pipe. Abo sketch the distribution of velocity and shear stress across a section of the pipe. 12

   (b) Derive an expression for the coefficient of viscusity in case of a dash pot arrangement. 8

6. (a) In a pipe of diameter 300 mm the centre line velocity and the velocity at a point 100 mm from the centre, as measured by pilot tube, are 2.4 m/s and 2.0 m/s respectively. Assuming the flow in a pipe to be turbulent find :

   (i) Discharge through the pipe

   (ii) Coefficient of friction

   (iii) Height of roughness projections. 12

   (b) Derive an expression for the Power transmission through the pipes. Find also the condition for maximum transmission of power. 8

UNIT–IV

7. (a) Differentiate between a stream lined body and a bluff body. 6

   (b) Explain the physical significance of the following :

   (i) Boundary layer thickness

   (ii) Displacement thickness

   (iii) Momentum thickness

   (iv) Energy thickness

   in relation with the boundary layer concept. 8

   (c) A smooth plate 2 m wide and 2.5 m long is towed in oil (sp. gravity = 0.8) at a velocity of 1.5 m/s along its length. Find the thickness of boundary layer and shear stress at the trailing edge of the plate. $\nu_{oil} = 10^{-4} m^2/sec$. 6

8. (a) Distinguish between hydrodynamically smooth and rough boundaries. 6

   (b) Explain, what is meant by boundary layer separation. Describe with sketches the methods to control separation. 8

   (c) What are the factors on which the total drag of a body fully immersed in a Fluid depend ? 6

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8642

BT–6 / M12

REFRIGERATION AND AIR-CONDITIONING

Paper– ME–302 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Attempt any five questions, selecting at least one question from each unit. Use of psychrometric chart and refrigeration table are allowed. Take suitable assumptions wherever necessary.

Unit–I

1. (a) A cold storage is to be maintained at – 4°C while the surroundings are at 34°C. The heat leakage from the surroundings into the cold storage is estimated to be 30 kW. The actual COP of the refrigeration plant is one third of an ideal plant working between the same temperatures. Find the power required to drive the plant. 10

(b) A Bell-Coleman refrigerator operates between pressure limits of 1bar and 8 bar. Air is drawn from the cold chamber at 9°C, compressed and then it is cooled to 29°C before entering the expansion cylinder. Expansion and compression follow the law $pV^{1.3}$ = const. Calculate the theoretical COP of the system.

For air take $\gamma = 1.4$ and $C_p = 1.003$ kJ/kg.K. 10

2. (a) A simple air-cooled system is used for an aeroplane having a load of 9 tons. The atmospheric pressure and temperature are 0.9 bar and 10°C respectively. During ramming pressure increases to 1.013 bar, In the heat exchanger the temperature of air is reduced by 55°C. The pressure in the cabin is 1.01 bar and the temperature of air leaving the cabin is 25°C. Find out (i) power required to take the load of cooling in the cabin (ii) COP of the system.

Assume that all the expansions and compressions are isentropic. The pressure of the compressed air is 4 bar. 12

(b) Write short notes on the following :

(i) Adiabatic demagnetization

(ii) Evaporative aircraft refrigeration. 8

Unit–II

3. (a) A refrigeration plant comprises three evaporators of capacities 10 tons at 12°C, 20 tons at 7°C and 30 tons at –5°C with individual expansion valves and individual compressors but one condenser operating at 40°C and sub cooling the liquid to 30°C. All the evaporators discharge dry saturated refrigerant R-12 of the compressor. Assume isentropic compression in each compressor. Find out :

(i) refrigeration effect in each evaporator

(ii) mass flow rate in each evaporator

(iii) compressor power required in each compressor

(iv) Heat rejected in the condenser

(v) COP

Draw a neat sketch of the cycle. 15

(b) With the help of p-h diagram distinguish between dry and wet compression. 5

4. (a) In an absorption type refrigerator, the heat is supplied to ammonia generator by condensing steam at 2 bar and 88% dry. The temperature in the refrigerator is to be maintained at −4°C. Find the maximum C. O. P. possible.

If the refrigeration load is 18 tons and actual C.O.P. is 72% of the maximum C. O. P., find the mass of steam required per hour. Take the temperature of the atmosphere as 25°C. 10

(b) Discuss the various methods to improve the COP of a simple vapour compression refrigeration system. 5

(c) Discuss in brief on 'nomenclature of refrigerants'. 5

Unit–III

5. (a) Room temperature at 20°C DBT and 50% RH is mixed with outdoor air at 40°C DBT and 30% RH in the ratio of 4:1. The mixture is passed through a cooling coil whose temperature is maintained constant at 10°C whose by-pass factor is 0.2. Determine the following :

(i) condition of air before entering the cooling coil

(ii) condition of air leaving the coil

(iii) refrigeration load on the cooling when 250m³/min of air is supplied to the room. 15

(b) Define 'RSHF' and 'coil by-pass factor'. 5

6. (a) 150m³ of air per minute is passed through the adiabatic humidifier. The condition of air at inlet

is 35°C DBT and 20% RH and the outlet condition is 20°C DBT and 15°C WBT. Determine the following :

(i) Dew point temperature

(ii) RH of the exit air

(iii) Amount of water vapour added to the air per minute 15

(b) Write a short note on 'psychrometric chart'. 5

Unit–IV

7. An air-conditioned auditorium is to be maintained at 27°C DBT and 55% RH. The ambient condition is 39°C DBT and 28°C WBT. The total sensible heat load is 120000 kJ/h and the total latent heat load is 45000 kJ/h. 60% of the return air is recirculated and mixed with 40% of make up air after the cooling coil. The condition of air leaving the coil is 17°C. Determine (i) RSHF

(ii) condition of air entering the auditorium

(iii) amount of make-up air

(iv) apparatus dew point

(v) by-pass factor of the cooling coil. 20

8. Write short notes on the following :

(i) Year round air-conditioning

(ii) Solar heat gain

(iii) Evaporative condenser

(iv) Cooling towers. 20

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8643

BT-6 / M12

TRIBOLOGY

Paper–ME-304-E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : This question paper contains eight questions in total. Candidates are required to attempt any five selecting atleast one from each unit. Each question carries equal marks. Use of non-programmable scientific calculator is allowed.

Unit–I

1. (a) Describe the stochastic tribo-model for the analysis of rough surface contact with asperities of non-uniform heights. 10

   (b) The surface height z with respect to a reference plane is given by : $z = 0.4 \sin(0.1 \pi x)$ where z and x are in μm and the sampling length is 40 μm. Calculate the rms roughness (σ) and the autocorrelation function ρ (β) for β = 0, 5, 10, 15 and 20 μm. Using these values of ρ (β), explain the physical significance of autocorrelation function. 10

2. (a) Explain any two techniques used for the measurement of surface topography. 10

   (b) State and explain the laws of sliding friction. Explain the adhesion theory of friction. 10

Unit–II

3. (a) Explain the mechanism of adhesive wear. Using Archard's theory, derive the expression for the wear volume due to adhesive wear. 10

   (b) Explain wear due to surface fatigue. 10

4. (a) Explain abrasive wear and its mechanism in detail. Also, discuss the quantitative law of abrasive wear. 10

   (b) Explain corrosive wear. How can it be minimized ? 10

Unit–III

5. (a) What are the functions of a lubricant ? Explain lubricant additives in detail. 10

   (b) Distinguish between hydrodynamic and hydrostatic lubrications. 10

6. (a) Distinguish between dry friction, boundary lubrication and elastohydrodynamic lubrication. 15

   (b) Explain the application of elastohydrodynamic lubrication in gears. 5

Unit–IV

7. (a) Explain hydrodynamic gas bearings in detail. 10

   (b) What are the desirable properties of bearing materials. Describe the various types of bearing materials. 10

8. (a) Explain hydrodynamic journal bearing. Derive the expression for film thickness and pressure distribution in an infinitely long hydrodynamic journal bearing. 10

   (b) A horizontal shaft (8 cm diameter) rotating at 500 RPM is supported by a journal bearing such that the eccentricity ratio is 0.2. The hydrodynamic pressure at an angular position of 60° with respect to the line of centers is 0.5 MPa. Assuming Half-Sommerfeld condition, calculate the minimum film thickness if the viscosity of the lubricant is 0.02 Pa.s. 10

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BT–6 / M12

MECHANICAL VIBRATIONS

Paper–ME–306–E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : (i) Attempt only five questions, at least one from each unit.

(ii) Unless stated otherwise, the symbols have their usual meanings in context with the subject. Assume suitably and state, additional data required, if any.

Unit–I

1. (a) A body is subjected to two harmonic motions as given below :

$X_1 = 15 \sin (\omega t + \pi / 6)$

$X_2 = 8 \sin (\omega t + \pi / 3)$

What extra harmonic motion should be given to the body to bring it to static equilibrium ? 8

(b) A force $P_0 \sin \omega t$ acts on a displacement $X_0 \sin (\omega t - \pi / 6)$. If $P_0 = 100$ N, $X_0 = 0.02$ m, $\omega = 2\pi$ rad/sec, find the work done during

(i) the first cycle,

(ii) the first second,

(iii) the first quarter second. 12

2. (a) A car having a mass of 1000 kg deflects its springs 4 cm under its load. Determine the natural frequency of the car in vertical direction. 2

(b) A uniform rod of mass 'M' and length 'L' rests on the curved surface of a fixed cylinder as shown in Figure 1. It is depressed slightly on one end and released. Find the frequency of resulting vibrations. 8

(c) Find the time period of small vibration of an inverted pendulum and spring system shown in Figure 2, given that the pendulum is vertical in

the equilibrium position. Compare the time period of vibration of the above system with that one in Figure 3, given that the pendulum is horizontal in the equilibrium position. 10

Unit–II

3. (a) A mass of 2 kg is supported on an isolator having a spring scale of 2940 N/m and viscous damping. If the amplitude of free vibration of the mass falls to one half its original value in 1.5 seconds, determine the damping coefficient of the isolator. 10

(b) An aircraft instrument of mass 10 kg is to be isolated from the engine vibrations. The engine runs at speeds ranging from 1800 rpm to 2500 rpm. Natural rubber isolators with negligible damping are used. Determine the rubber stiffness for 90% isolation. 10

ME – 306 E

4. Determine the two natural frequencies and the corresponding mode shapes for the system shown in the Figure 4. The string is stretched with a large tension T. 20

Unit–III

5. A four rotor system schematically represented in Figure 5 has the following physical quantities.

$J_1 = 817$ kg – m^2 $J_2 = 100$ kg – m^2

$J_3 = 608$ kg – m^2 $J_4 = 120$ kg – m^2

$k_{11} = 30 \times 10^6$ N – m/rad $k_{12} = 42 \times 10^6$ N – m/rad

$k_{13} = 42 \times 10^6$ N – m/rad $T_0 = 12000$ N – m

$\omega = 200$ rad/sec $G = 0.83 \times 10^{11}$ N/m^2

Find the amplitudes of vibration when the external torque acts on the first rotor as shown in the figure. If the diameter of each of the connecting shafts is 3 cm., find the maximum stress in each shaft section. 20

6. Find the lowest natural frequency of transverse vibrations for the system shown schematically in Figure 6 by Rayleigh's method taking into account the mass of the shaft which is given to be 4 kg. Take E = 1.96×10^{11} N/m^2, I = 10^{-6} m^4. Do at least four iterations. 20

Unit–IV

7. Determine the frequency equation in transverse vibration for a uniform beam of length L having one end fixed and the other simply supported. 20

8. Write short notes on following :

(i) Response of a second order undamped system to a pulse-input

(ii) Critical speeds of shafts. 10,10

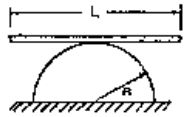

Figure 1

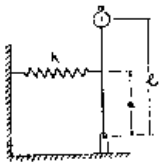

Figure 2

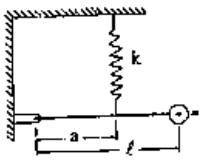

Figure 3

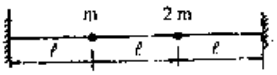

Figure 4

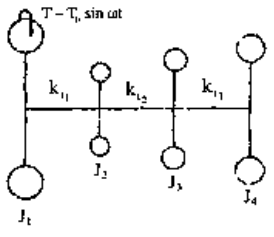

Figure 5

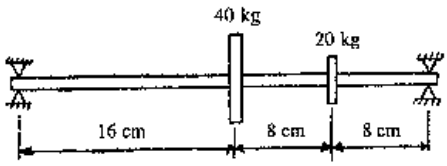

Figure 6

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BT–6 / M12

COMPUTER AIDED DESIGN AND MANUFACTURING

Paper– ME–308-E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *(i)* *Do five questions in all, selecting at least one question from each section.*

(ii) *Assume any missing data.*

(iii) *Draw neat and labeled diagrams to justify your answer where required.*

Unit–1

1. (a) What is coordinate system of modeling ? 10

   (b) Describe the importance of intrinsic equations. 10

2. What is group technology ? Discuss in detail. 20

Unit–2

3. (a) Differentiate between translation and rotation with the help of examples. 10

   (b) Discuss translation of a line by 21 units in -veY-direction. Assume the length and coordinates of the line. 10

4. (a) What is re-parameterization ? Give an example. 10

   (b) Find the radius and the centre of a circle passing through three points. 10

Unit–3

5. (a) What is tangent blending function ? Explain with an example. 10

   (b) Find the intersection point of two lines. Assume the equation of the lines by yourself. 10

6. Find the equation of closed (periodic) B-Spline curve defined by four control points. 20

Unit–4

7. (a) Describe different steps involved in Variant process planning. 10

   (b) What are different types of NC system ? 10

8. Write short notes on the following : 20

   (a) Product flow analysis

   (b) Flexible Manufacturing System

   (c) Computer Aided Process Planning

   (d) Perspective representation of solids.

8. (a) Explain clearly the requirement of automobile brakes. Discuss various factors influencing braking effect. 10

(b) Briefly describe construction and working of disc brakes. Compare them with the conventional drum type brakes. 10

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BT–7 / M 12

AUTOMOBILE ENGINEERING

Paper–ME–401–E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Attempt any five questions. Each question carries equal marks.

1. (a) Define an automobile. What are main components of an automobile ? Describe all of them briefly. 10

(b) Describe in detail multi-point fuel injection system and microprocessor based fuel supply systems in modern IC engines. 10

2. (a) What is the function and types of clutches ? Discuss various factors affecting the torque transmission in these clutches. 10

(b) With the help of suitable diagram, describe the constructional features of a helical spring type clutch. Discuss in brief the constructional features of a clutch plate. Also explain clearly the function of each major component of the clutch plate. 10

3. (a) What is the necessity of transmission in the vehicle ? Explain clearly. Also describe the working of synchromesh gear box with the help of a sketch. 10

(b) Describe briefly various types of gear selector mechanism used in automobile. Explain clearly how it is made sure in gear box that no time two gears are engaged simultaneously. 10

4. (a) What is the necessity of a differential in an automobile ? Discuss briefly the construction and operation of the differential. 10

(b) Explain with the help of neat diagram the construction of propeller shaft, constant velocity joint or universal joint used in automobiles. 10

5. (a) What are the objectives of vehicle suspension ? Differentiate clearly between the function of a spring and a shock absorber. Explain the construction and working of a telescopic type of shock absorber with the help of neat diagram. 10

(b) Explain the function and application of torsion bar and stabilizer bar. Explain clearly how it performs the same in actual practice. 10

6. (a) Discuss various factors of wheel alignment and explain the terms camber, caster, steering axis inclination and toe-in/out. What are effects of each on the steering characteristics of vehicle ? 10

(b) Discuss and explain clearly a steering linkage for a vehicle with independent suspension. 10

7. (a) State the various functions performed by an automobile tyre. Discuss the properties expected in the same. Draw cross-section of an automobile tyre and show on it various constructional features. 10

(b) Discuss different tyre-carcass types and materials used for them. Explain clearly the radial and bias-ply type carcass tyres. 10

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BT–6/M12

MACHINE DESIGN–II

Paper– ME-310–E

Time allowed : 4 hours] *[Maximum marks : 100*

Note : *Attempt five questions, selecting at least one question from each unit. Assume any missing data. Use of Machine Design Data Book is allowed.*

Unit–I

1. Design and draw a spur gear drive transmitting 30kW at 400 r.p.m. to another shaft running approximately at 100 r.p.m. The load is steady and continuous. The materials for the pinion and gear are cast steel and cast iron respectively. Take module as 10mm. Also check the design for dynamic load and wear. 20

2. Design worm and gear speed reducer to transmit 22kW at a speed of 1440 r.p.m. The desired velocity ratio is 24 : 1. An efficiency of atleast 85% is desired. Assume that the worm is made of hardened steel and the gear of phosphor bronze. 20

Unit–II

3. A Belt is required to transmit 15kW from a pulley 1.2m diameter at 300 r.p.m. to another pulley which runs at 500 r.p.m. The centre distance is 3m. The centre line of drive makes an angle of 45°with horizontal. Design a suitable flat leather belt for the drive. Also design the larger pulley. 20

4. A cone clutch is to be designed to transmit 7.5kW at 900 r.p.m. The cone has a face angle of 12°. The width of the face is half of the mean radius and the normal pressure between the contact faces is not to exceed 0.09N/mm^2. Assuming uniform wear and the coefficient of friction between the contact faces as 0.2, find the main dimensions of the clutch and the axial force required to engage the clutch. 20

Unit–III

5. A vertical spring loaded valve is required for a compressed air receiver. The valve is to start opening at a pressure of 1N/mm^2 gauge and must be fully open with a lift of 4mm at a pressure of 1.2N/mm^2 gauge.The diameter of the port is 25mm. Assume the

allowable shear stress in steel as 480 MPa and shear modulus as 80 kN/mm^2.

Design a suitable close coiled round section helical spring having squared ground ends. Also specify initial compression and free length of the spring. 20

6. Design a journal bearing for a centrifugal pump running at 1440 r.p.m. The diameter of the journal is 100mm and load on each bearing is 20kN. The vactor ZN/p may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C temperature and the atmosphere temperature is 30°C. The energy dissipation coefficient is 875 W/m^2/°C. Take diametral clearance as 0.1mm.

Unit–IV

7. Design a cast iron flywheel for a four stroke cycle engine to develop 110kW at 150 r.p.m. The work done in the power stroke is 1.3 times the average work done during the whole cycle. Take the mean diameter of the flywheel as 3m. The total fluctuation of speed is limited to 5 per cent of the mean speed. The material

density is 7250 kg/m^3. The permissible shear stress for the shaft material is 40 MPa and flexural stress for the arms of the flywheel is 20MPa. 20

8. Design a cast iron trunk type piston for a single acting four stroke engine developing 75kW per cylinder when running at 600 r.p.m. The other available data is as follows :

Maximum gas pressure = 4.8N/mm^2; Indicated mean effective pressure = 0.65 N/mm^2; Mechanical efficiency = 95%; Radius of crank = 110 mm; Fuel consumption = 0.3kg/BP/hr; Calorific value of fuel (higher) = 44 × 10^{3}kJ/kg; Difference of temperatures at the centre and edges of the piston head = 200°C; Allowable stress for the material of the piston = 33.5MPa; Allowable stress for the material of the piston rings and gudgeon pin = 80 MPa; Allowable bearing pressure on the piston barrel = 0.4N/mm^2 and allowable bearing pressure on the gudgeon pin = 17N/mm^2.

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BT–7 / M12

MEASUREMENT AND CONTROL

Paper–ME–403–E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Attempt any five questions, selecting at least one question from each unit. Assume any missing data.

Unit–I

1. (a) Differentiate between Primary, Secondary and Tertiary types of measurements. Cite suitable examples for each case. 10

   (b) Describe with examples the applications of Measurement systems. 10

2. (a) What are the different sources of errors in the measurements and measuring instruments ? Explain. 10

   (b) Define the following terms :

   (i) Repeatability

   (ii) Accuracy

   (iii) Hysteresis

   (iv) Drift. 10

Unit–II

3. Show that, when a step input is applied to a first order system, the output reaches 0.63 of the step value after time equal to time constant of the system.

   A thermometer has been suddenly plunged into a steaming water bath whose temperature remains steady at 100° C. It takes 10 seconds for the thermometer to reach the equilibrium condition which occurs at five time constant ($t = 5\tau$). Calculate the time constant and the time taken by the thermometer to indicate half of the temperature difference. The initial thermometer temperature can be considered to be zero. 20

4. The following data are expected to follow a linear relationship of the form $y = ax + b$. Obtain the best linear relation in accordance with a least square analysis. Calculate the standard deviation of the data from the result.

x	0.9	2.3	3.3	4.5	5.7	6.7
y	1.1	1.6	2.6	3.2	4.0	5.0

20

Unit–III

5. (a) Describe the principle of operation of a piezo-electric transducer. Identify the input and output of the system. 10

   (b) Mention some natural and synthetic materials that exhibit piezo-electric effect. 5

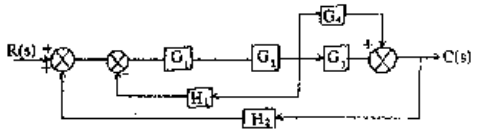
   (c) Explain why it is desirable that piezo-electric transducers should be used for the measurement of dynamic quantities only ? 5

6. (a) What are Proving rings ? Explain how they can be used for measurement of force using a vibrating reed and a micrometer. 10

   (b) What are Load cells ? Explain the working of Load cell using strain gauges. 10

Unit–IV

7. What do you mean by Transfer function ? Determine the transfer function for the following block. 20



8. Write short notes on :

   (a) Pneumatic nozzle

   (b) Hydraulic pump. 20

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BT–8/M12

ENTREPRENEURSHIP

Paper–ME-402-E

Time allowed : 3 hours] *[Maximum marks :100*

Note : Attempt five questions, selecting at least one from each unit.

Unit–I

1. (a) Explain the concept of 'Wealth' and 'Want'. 6
   (b) Discuss the importance of economics for engineers. 7
   (c) State the causes of depreciation. 7

2. (a) Describe in brief the elements of cost. 10
   (b) An old car was purchased for Rs. 32,000. Its life was estimated as ten years and the scrap value as Rs. 8000. Using the reducing balances method, calculate the percentage depreciate rate. Also estimate the depreciation fund at the end of two years. 10

Unit–II

3. (a) Explain the reasons for replacement of equipments or machinery. 10
   (b) Given below is the data for two equipments. Find out which alternative you will select :

	Equipment–1	Equipment–2
Initial Cost (P)	Rs. 10,000	Rs. 15,000
Annual Operating Cost	Rs. 1,000	Rs. 800
Life of equipment	8 years	8 years
Salvage value (L)	Rs. 1,000	Rs. 3,000

   Interest rate (i) = 5%, CRF for 8 years, is 0.1547. 10

4. (a) What is entrepreneurship ? Discuss the role of entrepreneur in Indian Economy. 10
   (b) Explain some myths and realities about entrepreneurship. 10

Unit–III

5. (a) Explain the steps in launching own venture. 10
   (b) Describe the procedure for registration of small scale industries. 10

6. (a) State the requirements of a good product design. 10
   (b) Explain rapid prototyping. 10

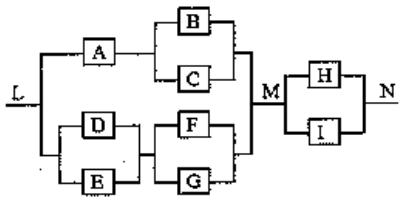
Unit–IV

7. (a) Describe some financial support programmes of banks for small scale industries. 10
   (b) What is the modern concept of marketing ? State functions of marketing. 10

8. Explain the steps in preparation of techno economic feasibility report of a manufacturing small enterprise. 20

7. (a) Describe MTBF and failure rate. 8

(b) A system of combination of series and parallel elements is shown below with the reliability of elements. Determine the over all reliability of the system.



Given :

$R_A = 0.95$, $R_B = R_C = 0.85$, $R_D = R_E = 0.8$,

$R_F = R_G = 0.75$, $R_H = R_I = 0.85$. 12

8. Write short notes on any *three* of following :

(a) Normal distribution curve

(b) Availability

(c) ISO

(d) u-charts. 20

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BT–7 / M 12

STATISTICAL QUALITY CONTROL AND RELIABILITY

Paper–ME–405 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt any five questions.*

1. (a) Explain the concept of TQM and state its objectives. 10

(b) Discuss various components adding cost in a quality system using optimising quality cost curve. 10

2. (a) Explain cause and effect diagram. 10

(b) Discuss the concepts of Juran in building a quality system. 10

3. (a) What is process capability ? Explain its various cases with the help of neat diagrams. 10

(b) Using the hypergeometric formula, compute the probabilities of zero through four defectives in a sample of 5 drawn from a lot of 40 which is 10% defective. 10

4. (a) What is control chart ? Discuss theory of control charts. 8

(b) In a factory producing spark plug, the number of defectives found in inspection of 20 lots of 100 each, is given below : 12

Lot No.	No. of defectives	Lot No.	No. of defectives
1	5	11	4
2	10	12	7
3	12	13	8
4	8	14	3
5	6	15	3
6	4	16	4
7	6	17	5
8	3	18	8
9	3	19	6
10	5	20	10

(i) Construct appropriate control chart and state whether the process is in statistical control.

(ii) Determine the sample size when a quality limit not worse than 9% is desirable and a 10% bad product will not be permitted more than 3 times in thousand. 12

5. (a) Define 'Producer's risk' and 'Consumer's risk'. 4

(b) What do you understand by a sampling plan ? Discuss a single sampling plan with stated producer's and 'consumer's risks with the help of neat diagram. 16

6. (a) Discuss the procedure of construction of AOQ curve. 7

(b) What is Redundancy ? Discuss the effect of placing redundancy in a system. 8

(c) Describe MTTR. 5

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BT-8 / M12

POWER PLANT ENGINEERING

Paper–ME-404 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Attempt five questions selecting atleast one from each unit. Missing data, if any, may be suitably assumed.

Unit–I

1. What are conventional and non-conventional sources of energy ? Explain relevance of non-conventional energy sources in modern times. 20

2. (a) Explain the procedure of site selection for hydropower projects. 10

   (b) Explain advantages and disadvantages of hydropower plants. 10

Unit–II

3. Explain constructional details and working of velox boiler. 20

4. (a) Explain constructional details and working of Economiser. 10

   (b) Explain advantages and disadvantages of diesel power plant over thermal power plant. 10

Unit–III

5. (a) Explain combined stream and gas turbine plant. 10

   (b) Explain nuclear fission and fusion processes. 10

6. (a) Explain Fission chain reaction. 10

   (b) Write a note on disposal of nuclear waste. 10

Unit–IV

7. The peak load on a power station is 30 MW. The load having maximum demands of 25 MW, 10MW, 5MW and 7 MW are connected to the power station. The capacity of power station is 40 MW and annual load factor is 50%, Find (a) average load on the power station (b) energy supplied (c) Demand factor (d) Diversity factor. 20

8. (a) How cost of energy is determined ? Explain. 10

   (b) Explain different tariff methods. 10

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BT–7 / M12

ADVANCED MANUFACTURING TECHNOLOGY

Paper–ME–419-E Opt. (I)

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Attempt any five questions, selecting at least one question from each unit.

Unit–I

1. (a) Describe different plastic tooling materials. How are plastic toolings produced ? 10

   (b) Explain electroforming process in detail along with a neat sketch. 10

2. Describe in detail the fabrication procedures for Laminates, MMC and CMC. 20

Unit–II

3. Explain in detail the following processes :

   (a) Transfer Moulding 10

   (b) Injection Moulding 10

4. Write brief notes on the following :

   (a) Thread milling 10

   (b) Thread measurement and inspection 10

Unit–III

5. Discuss the effect of temperature, strain rate and Friction on metal forming processes. Also describe different methods of analysis of manufacturing processes. 20

6. Explain the following processes in detail :

   (a) Open die forging 10

   (b) Extrusion 10

Unit–IV

7. Describe the steps involved in the design of die casting dies. Discuss the important characteristics and materials of dies in die casting process. 20

8. Write short notes on the following :

   (a) Elements of costing 10

   (b) Steps in cost estimation. 10

exponential distribution with an average of 10 hours. If the average delay of ships waiting for berths is to be kept below 14 hours, how many berths should be provided at the port ?

8. Explain 'Theory of Games' and discuss in detail the importance of terminology used in game theory.

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BT–8 / M12

OPERATION RESEARCH

Paper–ME–406–E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt any five questions in all, selecting at least one question from each unit. All questions carry equal marks. Assume the missing data, if any*

Unit–I

1. Write a detailed note on the use of models for decision making. The answer should specifically cover the following : 20

   (a) Need for model building

   (b) Type of model appropriate to the situation.

   (c) Steps involved in the construction of the model.

2. Show by Simplex Method that the following L.P. problem has infinite number of non-basic feasible solutions. 20

   maximize $Z = 4x_1 + 10x_2$,

   subject to $2x_1 + x_2 \leq 10$,

   $2x_1 + 5x_2 \leq 20$,

   $2x_1 + 3x_2 \leq 18$,

   $x_1, x_2 \geq 0$.

Unit–II

3. Find the optimum solution to the following transportation problem in which the cells contain the transportation cost in rupees. 20

	W_1	W_2	W_3	W_4	W_5	Available
F_1	7	6	4	5	9	40
F_2	8	5	6	7	8	30
F_3	6	8	9	6	5	20
F_4	5	7	7	8	6	10
Required	30	30	15	20	5	100 (Total)

4. Consider the PERT network shown in fig. 1 below. Determine the float of each activity and identify the critical path if the scheduled completion time for the project is 20 weeks. Also identify the subcritical path. 20

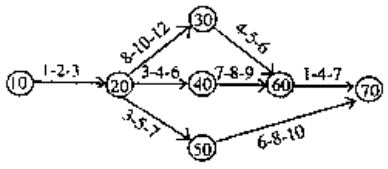

Fig. 1

Unit–III

5. Two persons A and B work on two station assembly line. The distributions of activity times at their stations are :

Time in sec.	Time frequency for A	Time frequency for B
10	3	2
20	7	3
30	10	6
40	15	8
50	35	12
60	18	9
70	8	7
80	4	3

   (a) Simulate operation of the line for eight items.

   (b) Assuming B must wait until A completes the first item before starting work, will he have to wait to process any of the other eight items ?

6. Explain the various steps involved in the Decision Theory Approach. Which are the decision criterions available for the condition of uncertainty ?

Unit–IV

7. Ships arrive at a port at the rate of 1 in every 4 hours with exponential distribution of inter arrival times. The time a ship occupies a berth for unloading has

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BT–8/M12

MANAGEMENT INFORMATION SYSTEMS

Paper–ME-432-E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt any five questions, selecting at least one from each unit.*

Unit–I

1. Briefly describe :
   (a) Decision Support Systems.
   (b) Systems View of Business. 10,10

Unit–II

2. Give a detailed account of basic information systems and how MIS assists in decision making. 20

3. Discuss different system objectives and how are these affected by defined problems and various system constraints ? How is the efficiency of a MIS system affected by various system objectives and system constraints ? 20

4. Discuss various steps in developing alternative detailed conceptual designs. How can these be documented ? 20

Unit–III

5. Explain the following .
   (a) Early System Testing.
   (b) Role of subsystems in enhancing efficacy of MIS. 10,10

6. Describe in detail, various parts of a proposal for an organization to operate the system. Also describe some hardware and software tools used for MIS. 20

Unit–IV

7. Discuss various features of space layouts for implementing MIS and also explain computer related acquisitions for developing a MIS. 20

8. Explain various steps in evaluation and maintenance of a MIS control system. What do you mean by soft spots in planning of MIS ? 20

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BT-8 / M12

TOTAL QUALITY MANAGEMENT

Paper–ME-426-E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : Attempt only five questions, selecting at least one question from each unit.

Unit–I

1. (a) Define the term Quality, Total Quality Management. Also discuss the key activities in a TQM system. 10

   (b) Enumerate Deming's fourteen points of Quality Management. 10

2. (a) Define Quality Leadership. What are the principles of Quality Leadership ? 10

   (b) Discuss the term Quality Circle. How a Quality Circle works in an industry ? 10

Unit–II

3. (a) Discuss Pareto diagram a[illegible] of construction.

   (b) Enumerate the concept of [illegible]

4. (a) Discuss the concept of SW[illegible] enhancing the quality o[illegible] institute.

   (b) How the SQC and SPC techniques a[illegible] in TQM ? Discuss with some suitable

Unit–III

5. What do you mean by ISO-9000 ? Discuss [illegible] requirements along with the benefits derived [illegible] same.

6. (a) What do you understand by "[illegible] How an internal audit is ca[illegible] industry ?

   (b) Explain the pitfall of ISO 9000.

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BT–7/M12

MAINTENANCE ENGINEERING

Paper–ME-437-E Opt-I

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt any five questions selecting at least one question from each unit.*

Unit–I

1. Explain the following terms :
   (a) Evolution of Maintenance 10
   (b) Economics of Maintenance. 10

2. Describe different maintenance programs ? Explain various functions and benefits of maintenance programs. 20

Unit–II

3. Explain the following terms :
   (a) Performance monitoring. 10
   (b) Thermography and corrosion monitoring. 10

4. What is TPM ? Explain the methodology and evolution of TPM. 20

Unit–III

5. Explain the following terms :
   (a) Ultrasonic Radiography. 10
   (b) Endoscopes. 10

6. Discuss Maintenance planning and control system. Describe the documentation requirement for a proper MPC system. 20

Unit–IV

7. Explain Maintainability. Also explain various techniques for improvement of operational reliability. 20

8. Write short notes on the following terms :
   (a) Maintainability program. 5
   (b) Key issues in availability improvement programs 5
   (c) Pareto analysis 5
   (d) Maintenance information and reporting systems. 5