Conventional Paper-II-2013

Section – A

1. (a) With the help of a free-body diagram, derive an expression for the effort P applied at the circumference of the screw to lift the load W. The coefficient of friction is μ and the helix angle is α.

(b) Sketch and explain the working of centrifugal clutch. Give one application of it.

(c) A thin cylindrical shell with hemispherical ends is subjected to internal fluid pressure. For equal maximum stress to occur in both the cylindrical and the spherical portions, what would be the ratio of thickness of the spherical portion to that of the cylindrical portion?

(d) Two closed coil helical springs A and B made of the same wire show axial compressions of 8 mm and 3 mm, respectively, when they are subjected to the same axial load. The spring A has 9 coils of mean diameter of 80 mm, while the spring B has 8 coils. Determine the mean coil diameter of the spring B.

(e) Explain the purpose of process annealing. How it is done? Discuss in short about bainite.

(f) Name four materials used as shaped tool in electrochemical machining. What types of materials are normally cut using high-pressure inert gas-assisted laser and why?

(g) Write the reasons which result the metals to shrink during solidification and cooling in metal casting. What are hot tears and cold shut?

(h) Explain the terms comminution and reduction used in powder metallurgy. Why lubricants are used to mix the metal powders?

(i) Name 4 basic ways of establishing a time standard?

(j) Consider the following formulas for statistics problems:

$$\text{Mean} = \mu = \frac{1}{N}\sum_{i=1}^{N} d_i$$

$$\text{Standard deviation} = \sqrt{\sigma}$$

$$\text{Variance} = \sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(d_i - \mu)^2$$

Write a C coding for the above.

Section – B

(Answer any two questions)

2. (a) At a point in a loaded component the state of stress is given by

$\sigma_x = 270\,\text{MPa},\ \sigma_y = 130\,\text{MPa}$ and $\tau_{xy} = \pm 40\,\text{Mpa}$.

Determine

(i) The maximum and minimum principal stresses and the planes on which they act.

(ii) The maximum shearing stress in magnitude and direction.

(b) One of the turning pairs of a four-bar chain is replaced by a sliding pair. Draw the inversions by fixing different links. Give one application for each of the mechanism.

(c) A 100 mm steel driving shaft transmitting 150 kW at 300 r.p.m has to be connected to a machine having same diameter shaft with a cast iron (CI) unprotected flange coupling. The permissible shear stress for the shaft, bolt and key are 50 MPa. The bearing stress for bolt and key are 50 MPa and shear stress for CI is 8 MPa. The basic dimensions of the coupling may be assumed as per the standard. Design the coupling and verify all the major dimensions for strength.

3. (a) A steel beam of rectangular section has a span of 8m and is simply supported at its ends. It is required to carry a total load of 60 kN uniformly distributed over the whole span. Find the minimum values of breadth and depth if the maximum bending stress is not to exceed 50 MPa, and the maximum deflection is limited to 10mm. $E = 210\,\text{GPa}$.

(b) (i) State the law of gearing to maintain the condition for constant velocity ratio between a pair of toothed wheels. Name two types of gear tooth profiles to satisfy these.

(ii) A pinion having 36 teeth drives a gear having 96 teeth. The profiles of the gears are involute with 20° pressure angle, 10mm module and 10mm addendum. Find the length of path of contact, arc of contact and contact ratio.

(c) In rotor system, three unbalanced masses $m_1 = 1.2\text{kg}$, $m_2 = 1.8\,\text{kg}$ and $m_3 = 2.4\,\text{kg}$. The radius and angular positions of these masses from the horizontal plane are: $R_1 = 1.135\text{m at}113.4°$, $R_2 = 0.822\,\text{m at } 48.8°$ and $R_3 = 1.04\,\text{m at } 251.4°$. Two balancing masses of m_A and m_B are on left and right ends of the rotor respectively. The distances of unbalanced masses and right side balance mass from the left end unbalance mass m_A are $\ell_1 = 0.854\text{m}$, $\ell_2 = 1.701\text{m}$, $\ell_3 = 2.396\text{m}$ and $\ell_B = 3.097\text{m}$.. Find the mass-radius product and angular locations of balancing masses m_A and m_B for dynamic balance of the rotor system.

4. (a) A hollow steel shaft 60 mm internal and 100mm external diameter is to be replaced by a solid alloy shaft. If the polar modulus has the same value for both, calculate the diameter of the latter and the ratio of their torsional rigidities. Shear modulus G for steel=2 times the G for the alloy.

(b) A vibrating system is characterized by the following parameters:

Mass = m = 6kg

Stiffness of spring = k = 200 N/m

Damping coefficient of the dashpot = c=6 N-s/m

Determine:

(i) The damping factor

(ii) The natural frequency of damped vibration

(iii) The number of cycles after which the original amplitude is reduced to 20 percent.

(c) A full journal bearing has a journal diameter D of 25mm, with a unilateral tolerance of -0.038mm. The bushing bore has a diameter B of 25.038mm and a unilateral tolerance of 0.075mm. The L/D ratio is unity. The load is 1.1 kN and the journal runs at 18.33 r.p.s. The average viscosity is 55.2 MPa-s.

Minimum film thickness variable is 0.58 and coefficient of friction variable is 4.0. Find

(a) Somerfield number

(b) Minimum film thickness

(c) Frictional torque.

(d) (i) Why are FCC metals generally weak and ductile ? Write the effects of adding chromium, nickel and molybdenum in steel.

(ii) Why plasticizers and lubricants are added to plastics ? Name some important properties and applications of (a) nylon and (b) vinyl.

Section – C

(Answer any two questions)

5(a). (i) Write the advantages, applications, current and power input that may be required in flash welding. Why flashing is essential?

(ii) In metal casting write the purpose and types of Muller. Why distortion allowance is provided on patterns?

5(b). (i) Name at least four methods by which high energy release rates are obtained. Why might less springback be observed in HERF?

(ii) Write at least four factors on which the thrust force in drilling depends.

A hole is being drilled on a block aluminum alloy with 10mm drill at a feed of 0.25 mm/rev. The spindle is running at N=850 r.p.m. Calculate the metal removal rate.

5(c). (i) Why does titanium have poor machinability? Write at least four general characteristics that coatings for cutting tools and dies should possess.

You are asked to turn ductile cast iron with various microstructure and hardness as shown in the following table.

	Hardness (HB)	Ferrite	Pearlite
1. Annealed	186	97	3
2. As cast	265	20%	80%
3. Annealed	170	100	-
4. As cast	207	60	40

Draw a figure showing variation of tool life with cutting speed and the effect of work piece hardness and microstructure.

(ii) Schematically illustrate closed loop control system for a numerical control machine, mentioning the purpose of a feedback control. Write the advantages of CNC over conventional NC systems.

6(a). (i) Define the terms accuracy and precision. Name five main areas into which the measurement can be divided. Write the amount of allowance and tolerance that is permitted by the following classes of fit as per ANSI class 4: Snug fit and class 7: Medium force fit. Also mention applications.

(ii) Write two advantages of thread rolling and explain with figure two-die cylindrical machine.

6(b). (i) Milling is an interrupted cutting process, show with figure conventional face milling with cutting force diagram for Fe showing the above nature of the process.

(ii) Name the basic components of all robots. Write in short about welding robot.

(c) The demand for a certain raw material used in manufacturing organization varies from month to month. The consumption pattern of the material during the last six months (in metric tons) is given below:

Table: Consumption pattern of raw material (metric tons)

Month	Demand
Month 1	20
Month 2	30
Month 3	20
Month 4	40
Month 5	50
Month 6	60

(i) Using the method of moving averages, forecast the demand for month 7using three period moving average

(ii) Suppose the three periods have the weights of 0.50 for the immediate past and 0.25 for two and three periods before. What will be the new forecast?

(iii) Changing the number of period for moving average to 2, 4 and 5, obtain the forecast in each of these cases.

(iv) What do you conclude from the results obtained in (i), (ii) and (iii)?

7. (a) A die making unit is planning to install a new CNC electric discharge machine in its job shop. Machines from two reputed manufacturers are available in the market. The relevant data about their products is as under:

	Manufacturer A	Manufacturer B
Present cost	`. 1.00 cr	`. 1.50 cr
Annual operating + maintenance cost	`. 0.20 cr	`. 0.12 cr
Salvage value at the end of useful life	`. 0.05 cr	`. 0.02 cr
Estimated useful life	10 years	10 years

Considering rate of return to be 12% per year, what is the best alternative?

(P_{wf} – series at 12% for 10 years = 5.65;

(P_{wf} – single payment at 12% for 10 yrs = 0.322)

(b) A manufacturer operates three factories from which items are shipped to four warehouses. Factory to warehouse shipping cost in rupees, quantities available at each of the factories X, Y and Z and requirements at each of the warehouses A, B, C and D are given in the table below:

Factory	Warehouses				Quantity available
	A	B	C	D	
X	30	20	50	20	150
Y	20	10	40	40	240
Z	20	30	40	30	210
Quantity required	130	120	160	190	600

Determine initial feasible solution by

(i) North-west corner rule, and

(ii) Lowest cost entry method.

(c) A dual-card Kanban system needs to be designed for a manufacturing process that has a demand rate of 200 per hour of a certain item. The standard containers designed for the components can hold 25 items. The conveyance time and production time for the components are 30 minutes and one hour, respectively. Assume a safety factor of 10%.

(i) Identify the number of C-Kanbans and P-Kanbans required in the system.

(ii) If there is a rounding off involved in arriving at the number of Kanbans in the above case, compare the performance of the system when the number is rounded off to the immediate lower and next higher integer.