

Time Allowed : 3 Hours

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in English or in Bengali but all answers must be in one and the same language.

Answer any five questions

1. The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 r.p.m. The crank is 150 mm and the connecting rod is 600 mm long.
Determine graphically :
 - (i) Linear velocity and acceleration of the midpoint of the connecting rod, and
 - (ii) Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position. 40

2. (a) A leather belt is required to transmit 7.5 kw from a pulley 1.2 m in diameter, running at 250 r.p.m. The angle embraced is 165° and the coefficient of friction between the belt and the pulley is 0.3. If the safe working stress for the leather belt is 1.5 MPa, density of leather 1 Mg/m^3 and the thickness of belt is 10 mm, determine the width of the belt taking centrifugal tension into account. 20

- (b) Prove that the speed at which a belt should be run to transmit maximum power is that at which the maximum allowable tension is three times the centrifugal tension in the belt at that speed. 20

3. (a) A shaft fitted with a flywheel rotates at 250 r.p.m. and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque rises from 750 N-m to 3000 N-m uniformly during $\frac{1}{2}$ revolution and remains constant for the following revolution. It then falls uniformly to 750 N-m during the next $\frac{1}{2}$ revolution and remains constant for one revolution, the cycle being repeated thereafter.
Determine the power required to drive the machine and percentage fluctuation in speed, if the driving torque applied to the shaft is constant and the mass of the flywheel is 500 kg. with radius of gyration of 600 mm. 20

- (b) The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg. and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified. 20

4. (a) A steel girder of uniform section, 14 metres long is simply supported at its ends. It carries concentrated loads of 90 kN and 60 kN at two points 3 metres and 4.5 metres from the two ends respectively. Calculate
 - (i) the deflection at the points under the two loads &
 - (ii) the maximum deflection.

Given : $I = 64 \times 10^{-4} \text{ m}^4$ and $E = 210 \times 10^6 \text{ kN/m}^2$ 25

(b) A crane-chain whose sectional area is 6.25 cm^2 carries a load of 10 kN. As it is being lowered at a uniform rate of 40m/min., the chain gets jammed suddenly, at which time the length of the chain unwound is 10 m. Estimate the stress induced in the chain due to sudden stoppage. Neglect the weight of the chain.

Take $E = 2.1 \times 10^5 \text{ N/m}^2$

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5. (a) Calculate the equilibrium number of vacancies per cubic meter for copper at 1000°C . The energy for vacancy formation is 0.9 eV/atom, the atomic weight and density (at 1000°C) for copper are 63.5 g/mol and 8.4 g/cm^3 , respectively. Take Boltzmann's Constant as $8.62 \times 10^{-5} \text{ eV/atom-k}$.

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(b) For a 79.65 wt% Fe - 0.35 wt% C alloy at a temperature just below the eutectoid, determine the following :-

- (i) The fractions of total ferrite and cementite phases
- (ii) The fractions of the proeutectoid ferrite and pearlite
- (iii) The fraction of eutectoid ferrite.

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(c) Briefly state the differences between Pearlite and spherodite relative to microstructure and mechanical properties.

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6. (a) The voltage - length characteristic of a direct current arc is given by $V = (20 + 40l)$ Volts where, l is the length of arc in Cm. The power source characteristic is approximated by a straight line with an open circuit voltage = 80V and a short circuit current is 1000 amp.

Determine the optimum arc length and the corresponding arc power.

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(b) During an electric discharge drilling of 10 mm square hole in a low carbon steel plate of 5 mm thickness, brass tool and kerosene are used. The resistance and capacitance in the relaxation circuit are 50Ω and $10\mu\text{F}$ respectively. The supply voltage is 200V and the gap is maintained at such a value that the discharge takes place at 150V. Estimate the time required to complete the drilling process.

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7. (a) What do you understand by EOQ ? Explain graphically.

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(b) A Company has got a demand for particular part at 10,000 units per year. The cost per unit is Rs.2 and it costs Rs.36 to place an order to process the delivery. The inventory carrying cost is estimated at 9% of average inventory investment.

Determine :-

- (i) Economic Order Quantity (E O Q)
- (ii) Optimum member of orders placed per annum
- (iii) Minimum total cost of inventory per annum.

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8. (a) Give a flow chart for finding greatest among three members to visualize the working of the algorithm.

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(b) A file called "STUDENT.DAT" contains information such as student roll number, name and total marks.

Write a C Programme to create a file to store details of n students.

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