अधिव्याख्याता, उपयोजित यंत्रशास्त्र, तंत्रनिकेतन, महाराष्ट्र तंत्रशिक्षण
शिक्षक सेवा गट अ परीक्षा-२०१७

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प्रश्नपुस्तिका **O11** **संच क्र.** **Series No.** → **A**

चाळणी परीक्षा

एकूण प्रश्न : 80

वेळ : 3 (तीन) तास **एकूण गुण : 200**

सूचना

(1) सदर प्रश्नपुस्तिकेत **80** अनिवार्य प्रश्न आहेत. उमेदवारांनी प्रश्नांची उत्तरे लिहिण्यास सुरुवात करण्यापूर्वी या प्रश्नपुस्तिकेत सर्व प्रश्न आहेत किंवा नाहीत याची खात्री करून घ्यावी. असा तसेच अन्य काही दोष आढळल्यास ही प्रश्नपुस्तिका समवेक्षकांकडून लगेच बदलून घ्यावी.

परीक्षा-क्रमांक								
	केंद्राची संकेताक्षरे							शेवटचा अंक

(2) आपला परीक्षा-क्रमांक ह्या चौकोनांत **न विसरता बॉलपेनने** लिहावा.

(3) वर छापलेला प्रश्नपुस्तिका क्रमांक तुमच्या उत्तरपत्रिकेवर विशिष्ट जागी उत्तरपत्रिकेवरील सूचनेप्रमाणे **न विसरता नमूद करावा.**

(4) या प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाला 4 पर्यायी उत्तरे सुचविली असून त्यांना 1, 2, 3 आणि 4 असे क्रमांक दिलेले आहेत. त्या चार उत्तरांपैकी सर्वात योग्य उत्तराचा क्रमांक उत्तरपत्रिकेवरील सूचनेप्रमाणे तुमच्या उत्तरपत्रिकेवर नमूद करावा. अशा प्रकारे उत्तरपत्रिकेवर उत्तरक्रमांक नमूद करताना तो संबंधित प्रश्नक्रमांकासमोर छायांकित करून दर्शविला जाईल याची काळजी घ्यावी. **ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.**

(5) सर्व प्रश्नांना समान गुण आहेत. यास्तव सर्व प्रश्नांची उत्तरे द्यावीत. घाईमुळे चुका होणार नाहीत याची दक्षता घेऊनच शक्य तितक्या वेगाने प्रश्न सोडवावेत. क्रमाने प्रश्न सोडविणे श्रेयस्कर आहे पण **एखादा प्रश्न कठीण वाटल्यास त्यावर वेळ न घालविता पुढील प्रश्नाकडे वळावे.** अशा प्रकारे शेवटच्या प्रश्नापर्यंत पोहोचल्यानंतर वेळ शिल्लक राहिल्यास कठीण म्हणून वगळलेल्या प्रश्नांकडे परतणे सोईस्कर ठरेल.

(6) उत्तरपत्रिकेत एकदा नमूद केलेले उत्तर खोडता येणार नाही. नमूद केलेले उत्तर खोडून नव्याने उत्तर दिल्यास ते तपासले जाणार नाही.

(7) **प्रस्तुत परीक्षेच्या उत्तरपत्रिकांचे मूल्यांकन करताना उमेदवाराच्या उत्तरपत्रिकेतील योग्य उत्तरांनाच गुण दिले जातील. तसेच "उमेदवाराने वस्तुनिष्ठ बहुपर्यायी स्वरूपाच्या प्रश्नांची दिलेल्या चार उत्तरांपैकी सर्वात योग्य उत्तरेच उत्तरपत्रिकेत नमूद करावीत. अन्यथा त्यांच्या उत्तरपत्रिकेत सोडविलेल्या प्रत्येक चार चुकीच्या उत्तरांसाठी एका प्रश्नाचे गुण वजा करण्यात येतील".**

(8) (अ) प्रस्तुत परीक्षेसाठी Non-programmable Scientific calculator वापरण्यास परवानगी आहे.
(ब) उमेदवाराने परीक्षा कक्षात आणलेल्या calculator चा सिरीज क्रमांक हजेरीपटावर नमूद करावा.
(क) उमेदवाराने परीक्षेत programmable calculator वापरल्याचे आढळल्यास त्याची उमेदवारी रद्द करण्यात येईल.

ताकीद

ह्या प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपेपर्यंत ही प्रश्नपुस्तिका आयोगाची मालमत्ता असून ती परीक्षाकक्षात उमेदवाराला परीक्षेसाठी वापरण्यास देण्यात येत आहे. ही वेळ संपेपर्यंत सदर प्रश्नपुस्तिकेची प्रत/प्रती, किंवा सदर प्रश्नपुस्तिकेतील काही आशय कोणत्याही स्वरूपात प्रत्यक्ष वा अप्रत्यक्षपणे कोणत्याही व्यक्तीस पुरविणे, तसेच प्रसिद्ध करणे हा गुन्हा असून अशी कृती करणाऱ्या व्यक्तीवर शासनाने जारी केलेल्या "परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचा अधिनियम-82" यातील तरतुदीनुसार तसेच प्रचलित कायद्याच्या तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.

तसेच ह्या प्रश्नपत्रिकेसाठी विहित केलेली वेळ संपण्याआधी ही प्रश्नपुस्तिका अनधिकृतपणे बाळगणे हा सुद्धा गुन्हा असून तसे करणारी व्यक्ती आयोगाच्या कर्मचारीवृंदापैकी, तसेच परीक्षेच्या पर्यवेक्षकीयवृंदापैकी असली तरीही अशा व्यक्तीविरूद्ध उक्त अधिनियमानुसार कारवाई करण्यात येईल व दोषी व्यक्ती शिक्षेस पात्र होईल.

पर्यवेक्षकांच्या सूचनेविना हे सील उघडू नये

पुढील सूचना प्रश्नपुस्तिकेच्या शेवटच्या पानावर पहा

कच्च्या कामासाठी जागा/SPACE FOR ROUGH WORK

1. One of the four assumptions underlying the EOQ model is that

(1) the demand pattern follows a normal distribution over the order cycle.

(2) the purchase price per unit varies depending upon the quantity ordered.

(3) replenishment is instantaneous at the expiration of the lead time.

(4) the model makes allowance for stock out by including an understocking cost.

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2. Nitriding is a process for

(1) normalising (2) annealing

(3) tempering (4) case hardening

---

3. Find the initial basic feasible solution of the following transportation problem by Vogel's approximation method :

		Warehouse				
		W_1	W_2	W_3	W_4	Capacity
Factory	F_1	19	30	50	10	7
	F_2	70	30	40	60	9
	F_3	40	8	70	20	18
Requirement		5	8	7	14	34

(1) 634 (2) 834 (3) 434 (4) 638

---

4. A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine ?

(1) 1·392 kW (2) 0·392 kW

(3) – 1·392 kW (4) – 0·892 kW

---

5. The iron-carbon diagram and the TTT curves are determined under

(1) equilibrium and non-equilibrium conditions respectively.

(2) non-equilibrium and equilibrium conditions respectively.

(3) equilibrium conditions for both.

(4) non-equilibrium conditions for both.

---

6. For same compression ratio and same heat input

(1) Thermal efficiency of Otto cycle is greater than Diesel cycle

(2) Thermal efficiency of Diesel cycle is greater than Otto cycle

(3) Thermal efficiency of Otto cycle is same as Diesel cycle

(4) Thermal efficiency of Otto cycle cannot be predicted

---

7. Which type of colour and mark code is provided for wooden patterns (IS : 1513 – 1950) for machined openings ?

(1) Yellow

(2) Red or Orange

(3) Black on core prints

(4) Yellow strips on black on core prints

---

8. Dropwise condensation usually occurs on

(1) Glazed surface

(2) Smooth surface

(3) Rough surface

(4) Coated surface

---

9. In orthogonal turning of a mild steel bar of 60 mm diameter on a lathe, a feed of 0·8 mm was used. A continuous chip of 1·4 mm thickness was removed at a rotational speed of 80 rpm of work. Calculate the chip thickness ratio (r) and chip reduction ratio (k).

(1) $r = 0{\cdot}87,\ k = 2{\cdot}25$

(2) $r = 0{\cdot}57,\ k = 1{\cdot}75$

(3) $r = 0{\cdot}97,\ k = 1{\cdot}50$

(4) $r = 0{\cdot}37,\ k = 1{\cdot}25$

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10. Ultrasonic machining is chiefly employed for

(1) Hard and Ductile material

(2) Ductile and Brittle material

(3) Hard and Brittle material

(4) All of the above

---

11. The purpose of heat treatment process is to

(1) Improve mechanical and electrical properties

(2) Increase resistance to wear, heat and corrosion

(3) Change in chemical composition

(4) All of the above

---

12. In blanking operation, the clearance is provided on

(1) the die

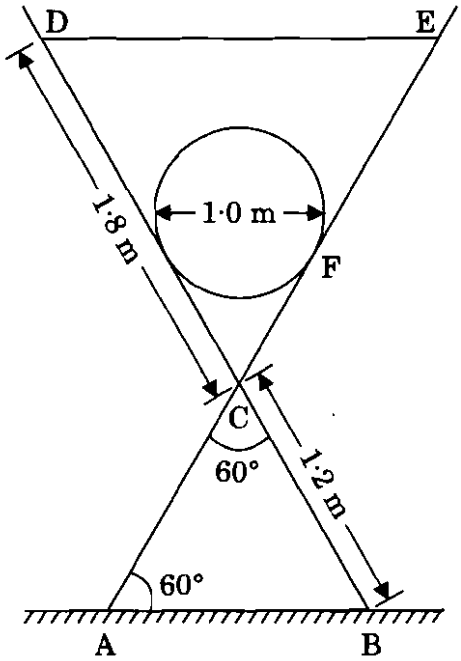
(2) the punch

(3) Both die and punch

(4) Neither the punch nor the die

---

13. A 500 N cylinder of 1 m diameter is loaded between the cross pieces which make an angle of 60° with each other and are pinned at C. Determine the tension in the horizontal rope DE, assuming a smooth floor.



(1) 0·586 kN

(2) 375·0 kN

(3) 0·374 kN

(4) 586·0 kN

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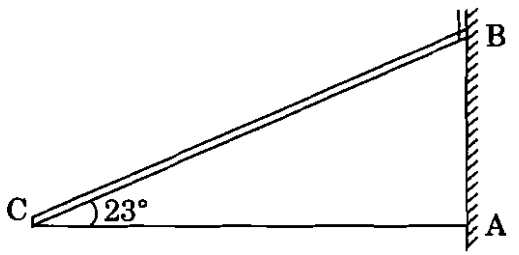
14. A prismatic bar, BC of length 11 m and mass 21 kg is hinged with vertical wall at B and is tied at other end with a strut, AC. The compressive force induced in the strut will be



(1) 205·947 N

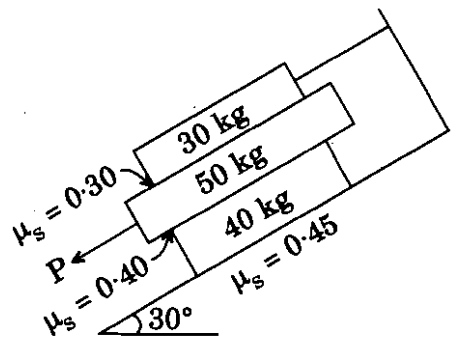
(2) 24·74 N

(3) 242·6 N

(4) 2380·66 N

---

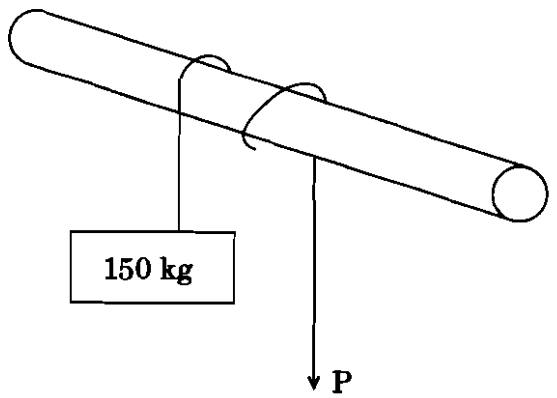
15. Three flat blocks are positioned on a 30° incline as shown and a force P parallel to the incline is applied to the middle block. The upper block is prevented from moving by a wire which attaches it to the fixed support. The coefficient of static friction for each of the three pairs of mating surfaces is shown. Determine the maximum value which P may have before any slipping takes place.



(1) 103·9 N (2) 46·3 N

(3) 83·9 N (4) 93·8 N

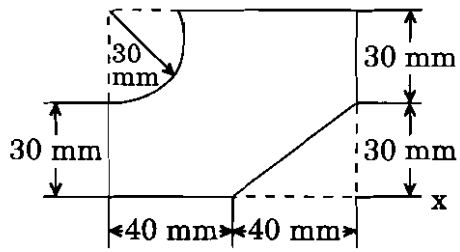
16. A 150 kg block is supported by a rope which is wrapped $1\frac{1}{2}$ times around a horizontal rod. Determine the force P required on the free end of the rope that is required to just support a 150 kg mass. The coefficient of friction between the rope and the rod is 0·16.



(1) 6651·18 N (2) 678 N

(3) 3193·65 N (4) 325·55 N

17. Calculate the radius of gyration about x-axis for the shaded area shown below.



(1) 0·066 m (2) 0·014 m

(3) 0·034 m (4) 0·056 m

---

18. The position coordinate of a particle which is confined to move along a straight line is given by $S = 2t^3 - 24t + 6$, where 'S' is measured in metres from a convenient origin and 't' is in seconds. The time required for the particle to reach a velocity of 72 m/sec from its initial condition at $t = 0$ will be

(1) 16 sec (2) 4 sec

(3) 5 sec (4) 2 sec

---

19. A 20-Mg railroad car moving at a speed of 0·5 m/sec to the right collides with a 35-Mg car which is at rest. If after the collision the 35-Mg car is observed to move to the right at a speed of 0·3 m/sec., the coefficient of restitution between the two cars will be

(1) e = 0·56

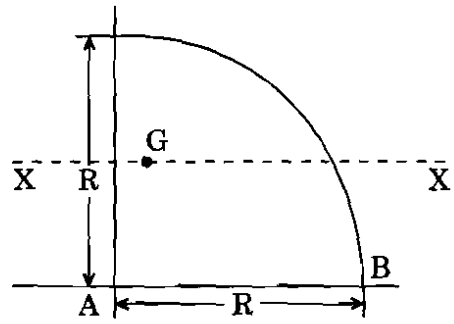
(2) e = 0·75

(3) e = 0·65

(4) e = 0·85

---

20. Moment of inertia of a quarter of a circle about the base AB is



(1) $\frac{\pi R^4}{16}$ (2) $\frac{\pi R^3}{16}$ (3) $\frac{\pi R^2}{4}$ (4) $\frac{\pi R}{16}$

---

21. A burglar's car had a start with an acceleration of 2 m/s^2. A police vigilant party came after 5 sec and continued to chase the burglar's car with uniform velocity of 20 m/s. Find the time taken in which the police will overtake the car.

(1) 20 sec (2) 10 sec (3) 3 sec (4) 5 sec

---

22. Plane motion of a rigid body will have

(1) translation only (2) rotation only

(3) Both translation and rotation (4) Neither translation nor rotation

---

23. A lift carries a weight of 3600 N and is moving with a uniform acceleration of 3·5 m/s^2. Let T_1 and T_2 be the tensions in the supporting cable when the lift is moving upwards and moving downwards respectively. Assuming g = 9·81 m/s^2, find the ratio T_1/T_2.

(1) 4·50 (2) 1·00 (3) 3·50 (4) 2·10

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24. A small projectile is fired vertically downward into a fluid medium with an initial velocity of 60 m/sec. Due to the resistance of the fluid, the projectile experiences a deceleration equal to a = [– 0·4 v^3] m/sec^2, where v is in m/sec. The projectile's velocity 4 sec after it is fired will be

(1) 0·559 m/sec (↓) (2) 4·43 m/sec (↓)

(3) 0·559 m/sec (↑) (4) 4·43 m/sec (↑)

---

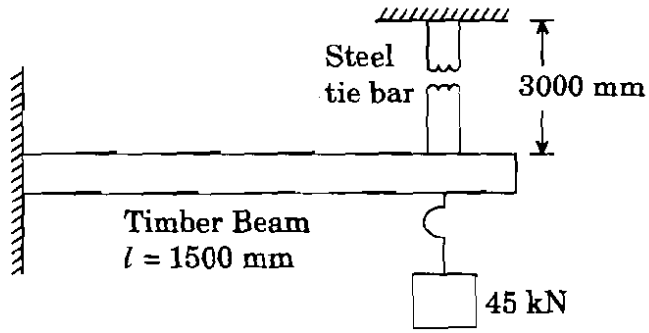
25. If the bar of elastic material is subjected to direct compressive stress of magnitude 'σ_1' in longitudinal direction. Suitable lateral compressive stress of magnitude 'σ_2' is applied in other two lateral directions, to limit the net strain in each of the lateral directions to half of the magnitude that could be under 'σ_1' acting alone. What is the magnitude of 'σ_2' in terms of 'σ_1' ?

(1) $\sigma_2 = \frac{1}{2} \frac{\mu}{1-\mu} \sigma_1$ (2) $\sigma_2 = \frac{\mu}{1-\mu} \sigma_1$

(3) $\sigma_2 = \frac{\sigma_1}{2}$ (4) $\sigma_2 = \frac{\mu \sigma_1}{2}$

---

26. The figure below shows a steel tie bar of sectional area 125 mm^2 supporting a timber beam. The moment of inertia of the beam section is $1{\cdot}95 \times 10^8$ mm^4. Find the axial force in the tie bar. Modulus of elasticity for steel = 2×10^5 N/mm^2 and modulus of elasticity for timber = 13750 N/mm^2.



(1) 34992 N (2) 36423 N

(3) 31249 N (4) 44992 N

---

27. A simply supported beam of span 'L' is subjected to triangular load whose intensity varies from zero at one end to 'W' per unit run at other end. What is the maximum bending moment in the beam ?

(1) $M_{max} = \frac{WL^2}{9\sqrt{3}}$ (2) $M_{max} = \frac{WL^3}{9\sqrt{3}}$

(3) $M_{max} = \frac{WL^2}{6\sqrt{3}}$ (4) $M_{max} = \frac{WL^2}{3\sqrt{3}}$

---

28. Hooke's law holds good within

(1) Instability point (2) Plastic limit

(3) Elastic limit (4) None of the above

---

29. Strain energy per unit volume stored in the body at its elastic limit is called as

(1) Resilience

(2) Proof Resilience

(3) Principal Strain

(4) Strain Rosette

---

30. For a beam of circular section, ratio of maximum shear stress to average shear stress is

(1) $\frac{1}{2}$ (2) $\frac{3}{2}$

(3) $\frac{4}{3}$ (4) 2

---

31. Which of the following theory gives satisfactory results for ductile materials ?

(1) Maximum strain energy theory

(2) Maximum shear stress theory

(3) Maximum principal stress theory

(4) Distortion energy theory

---

32. In a thin cylindrical shell with hemispherical ends, what is the ratio of wall thickness of cylindrical portion to wall thickness of hemispherical portion for achieving maximum stress to be same in both cylindrical and hemispherical portion ?

(1) 1 (2) 2 (3) 0·5 (4) 1·5

---

33. A helical spring is made of 12 mm diameter steel wire wound on a 120 mm diameter mandrel. If there are 10 active coils, what is the spring constant ?
Take modulus of rigidity c = 82 GN/m^2.

(1) 24600 N/m

(2) 2300 N/m

(3) 12300 N/m

(4) 4600 N/m

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34. Which one of the following assumptions is correct for analysis of thick cylinders based on Lame's theory ?

(1) The material of the cylinder is homogeneous and isotropic

(2) The material of the cylinder is non-homogeneous and isotropic

(3) The material of the cylinder is non-homogeneous, isotropic and does not obey Hooke's law

(4) None of the above

---

35. When two shafts are connected in parallel, then which of the following statements is true ?

(1) Both shafts are carrying same torque.

(2) Total angle of twist at resisting end is sum of the separate angles of twist of two shafts.

(3) The angle of twist in both shafts is same.

(4) None of the above

---

36. While designing a truss, in which material of the following is the factor of safety choosen maximum ?

(1) Cast Iron

(2) Wrought Iron

(3) Timber

(4) Mild Steel

---

37. When the motion between two elements of a pair is possible in more than one direction and depends upon the direction of the force applied, it is known as

(1) Completely constrained motion

(2) Incompletely constrained motion

(3) Successfully constrained motion

(4) None of the above

---

38. In a mechanism, the number of instantaneous centre of rotation is given by

(1) $\frac{n(n-1)}{2}$ (2) $\frac{2n(n-1)}{2}$

(3) $\frac{n(2n-1)}{2}$ (4) $\frac{n(n-2)}{2}$

---

39. The rate of change velocity along the radial direction is known as

(1) tangential acceleration

(2) centripetal acceleration

(3) coriolis acceleration

(4) None of the above

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40. The circle drawn to the cam profile with minimum radius is called the

(1) prime circle

(2) pitch circle

(3) base circle

(4) cam circle

---

41. A shaft runs at 80 rpm and drives another shaft at 150 rpm through belt drive. The diameter of the driving pulley is 600 mm. Determine the diameter of the driven pulley taking belt thickness as 5 mm.

(1) 305 mm (2) 307 mm

(3) 317·7 mm (4) 307·7 mm

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42. The following data refers to two meshing gears :

Velocity ratio = $\frac{1}{3}$

Module = 4 mm

Pressure angle = 20°

Centre distance = 200 mm

Determine the number of teeth of both gears.

(1) 25 and 75 (2) 20 and 60

(3) 30 and 90 (4) 22 and 66

---

43. In case of multi-plate friction clutch, if n is the total number of plates on both driving and driven members, the number of active friction surfaces is

(1) 2n

(2) n

(3) 2(n – 1)

(4) n – 1

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44. The ratio of the height of a Porter governor to that of a Watt governor when the lengths of the links and the arms are the same is,

(where, M = mass of sleeve

m = mass of each ball)

(1) $\frac{m + M}{M}$ (2) $\frac{m + M}{m}$

(3) $\frac{M}{M + m}$ (4) $\frac{m}{M + m}$

---

45. In a spring mass system, if the mass is halved and the spring stiffness is doubled, the natural frequency is

(1) halved (2) doubled

(3) unchanged (4) quadrupled

---

46. ASME code for shaft design is based on which one of the following theories of failure ?

(1) Maximum principal stress theory

(2) Distortion energy theory

(3) Maximum strain theory

(4) Maximum shear stress theory

---

47. A shaft of diameter 'd' has keyway having width 'w' and height 'h'. Another shaft of same material and diameter as that of the previous one, does not have keyway. The ratio of torsional strength of shaft having a keyway and torsional strength of same sized shaft without keyway is given by

(1) $c = 1 - \left(\frac{w}{d}\right) - \left(\frac{h}{d}\right)$

(2) $c = 1 - 0{\cdot}2\left(\frac{w}{d}\right) - 1{\cdot}1\left(\frac{h}{d}\right)$

(3) $c = 1 - \left(\frac{w}{d}\right) - 1{\cdot}1\left(\frac{h}{d}\right)$

(4) $c = 1 - 0{\cdot}2\left(\frac{w}{d}\right) - \left(\frac{h}{d}\right)$

---

48. A clutch has external and internal diameters of 100 mm and 50 mm respectively. Assume uniform pressure of 2 MPa and coefficient of friction 0·4. The torque transmitting capacity of the clutch will be

(1) 183 Nm

(2) 284 Nm

(3) 150 Nm

(4) 200 Nm

---

49. Two shafts of same material and equal lengths are subjected to same torque. First shaft is solid with diameter 'D' and other shaft is hollow with outer diameter equal to the diameter of solid shaft and inner diameter 'd'. What is the ratio of angle of twist of solid shaft to that of hollow shaft ?

(1) $\left[1-\left(\frac{d}{D}\right)^4\right]$

(2) $\left[1-\left(\frac{D}{d}\right)^4\right]$

(3) $\left[1-\left(\frac{d}{D}\right)^3\right]$

(4) $\left[1-\left(\frac{D}{d}\right)^3\right]$

---

50. A spur gear transmits 10 kW at a pitch line velocity of 10 m/s, driving gear has diameter of 1 m. The tangential force between the driver and the follower and transmitted torque respectively will be as follows :

(1) 1 kN and 0·5 kNm

(2) 10 kN and 5 kNm

(3) 0·5 kN and 0·25 kNm

(4) 1 kN and 1 kNm

---

51. In a concentric spring, if 'C' is the spring index, what is the ratio of wire diameter of outer spring to that of inner spring ?

(1) C (2) $\frac{1}{C-2}$

(3) $\frac{C}{C-2}$ (4) $\frac{C}{2}$

---

52. A plate clutch consists of 1 pair of contacting surfaces. The inner and outer diameter of the friction disk is 100 mm and 200 mm respectively. The coefficient of friction is 0·2 and permissible intensity of pressure is 1·5 N/mm^2.
Assuming uniform wear theory, calculate the axial force required to engage the clutch.

(1) 15546 N (2) 12344 N

(3) 23562 N (4) 24543 N

---

53. If 'Z' is the number of teeth on sprocket wheel, then the variation in velocity $(v_{max} - v_{min})$ of chain drive is directly proportional to

(1) $\left[1 - \cos\left(\frac{180}{Z}\right)\right]$

(2) $\left[1 - \sin\left(\frac{180}{Z}\right)\right]$

(3) [1 – cos (Z)]

(4) [1 – sin (Z)]

---

54. Maximum efficiency of a square threaded power screw for friction angle of 30 degree is

(1) 33%

(2) 50%

(3) 45%

(4) 66%

---

55. The strength of transverse fillet weld is _____ times the strength of parallel fillet weld.

(1) 1·17

(2) 1·27

(3) 2·17

(4) 2·27

---

56. A square matrix in which all the elements below the principal diagonal are zero, is

a. Hermitian matrix and Skew Hermitian matrix.

b. Upper triangular matrix.

c. Lower triangular matrix.

d. Unitary matrix.

(1) Only a, b and c (2) Only b

(3) Only c (4) Only b and c

---

57. If 'ω' is complex cube root of unity, then rank of the matrix

$$A = \begin{bmatrix} 1 & \omega & \omega^2 & \omega^3 \\ \omega & \omega^2 & \omega^3 & 1 \\ \omega^2 & \omega^3 & 1 & \omega \\ \omega^3 & 1 & \omega & \omega^2 \end{bmatrix} \text{ is}$$

(1) 1 (2) 2 (3) 3 (4) 4

---

58. Find the matrix A, if $\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix} A \begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} -2 & 4 \\ 3 & -1 \end{bmatrix}$.

(1) $\begin{bmatrix} 14 & 8 \\ 4 & 3 \end{bmatrix}$ (2) $\begin{bmatrix} 2 & -1 \\ -3 & 2 \end{bmatrix}$

(3) $\begin{bmatrix} 24 & 13 \\ -34 & -18 \end{bmatrix}$ (4) $\begin{bmatrix} 3 & 2 \\ 5 & 3 \end{bmatrix}$

---

59. What is the general solution of the following higher order linear differential equation with constant coefficient ?

$$\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = e^{3x}$$

(1) $y = c_1 e^x + c_2 e^{2x} + \frac{1}{2} e^{3x}$ (2) $y = c_1 e^{2x} + c_2 e^{-3x} + \frac{1}{3} e^{3x}$

(3) $y = c_1 e^{-x} + c_2 e^{-3x} + \frac{1}{2} e^{-3x}$ (4) $y = c_1 e^{-2x} + c_2 e^{-x} + \frac{1}{3} e^{-3x}$

---

60. The variables x and y satisfy the differential equation

$$4\frac{dx}{dt} = y - x = 2\frac{dy}{dt}$$

then 'x' as a function of 't' is given by

(1) $x = A + B\,e^{t/4}$ (2) $x = A + B\,e^{-t/4}$

(3) $x = (A + Bt)\,e^{-t/4}$ (4) $x = (A + Bt)\,e^{t/4}$

---

61. A vector field is given by $F = \sin y\, i + x(1 + \cos y)\, j$. Evaluate the line integral over a circular path given by $x^2 + y^2 = a^2,\ z = 0$.

(1) πa^2 (2) πa (3) a^2 (4) $\frac{\pi a^2}{4}$

---

62. If $L[1] = \frac{1}{s}$, $L[t] = \frac{1}{s^2}$, then $L[t^n]$ is

(1) $\frac{n!}{s^n}$ (2) $\frac{n!}{(s+1)^n}$

(3) $\frac{n!}{s^{n+1}}$ (4) $\frac{(n+1)!}{s^n}$

---

63. Solution of the differential equation $y(\log y)\,dx + (x - \log y)\,dy = 0$ is

(1) $x = \frac{1}{2}\log y + c(\log y)^{-1}$ (2) $x = \log\sqrt{y} - c(\log\frac{1}{y})$

(3) $y = \frac{1}{2}\log x + c(\log x)^{-1}$ (4) $y = -\frac{1}{2}\log x + c(\log x)^{-1}$

---

64. By Euler's method to approximate the solution of initial value problem

$$\frac{dy}{dt} = -2ty^2 \text{ with } y(0) = 1$$

in the interval $0 \le t < 0{\cdot}5$ $(h = 0{\cdot}1)$,

the value of y_3 is

(1) 0·9404 (2) 0·9416 (3) 0·9998 (4) 0·9890

65. The Laplace transform of $e^{-2t} \sin^2 4t$ is

(1) $L\left[e^{-2t} \sin^2 4t\right] = \frac{1}{2}\left[\frac{1}{s+2} - \frac{s+2}{(s+2)^2+64}\right]$

(2) $L\left[e^{-2t} \sin^2 4t\right] = \frac{1}{2}\left[\frac{2}{s+2} - \frac{2}{(s+2)^2+64}\right]$

(3) $L\left[e^{-2t} \sin^2 4t\right] = \frac{1}{2}\left[\frac{2}{s+2} + \frac{s+2}{(s+2)^2+64}\right]$

(4) None of the above

---

66. Solve :

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x \sin x$$

(1) $y = (c_1 + c_2 x)\, e^{-x} - e^x (x \sin x + 2 \cos x)$

(2) $y = (c_1 + c_2 x)\, e^{x} - e^x (x \sin x + 2 \cos x)$

(3) $y = (c_1 + c_2 x)\, e^{x} + e^{-x} (x \sin x - 2 \cos x)$

(4) $y = (c_1 + c_2 x)\, e^{-x} - e^x (-x \sin x - 2 \cos x)$

---

67. The values of a, b and c such that the formula $\int_0^h f(x)\,dx = h\left[af(0) + bf\left(\frac{h}{3}\right) + cf(h)\right]$ is exact for polynomial of a high order as possible are

(1) $a = 0, b = \frac{3}{4}, c = \frac{1}{4}$

(2) $a = \frac{3}{4}, b = 0, c = \frac{1}{4}$

(3) $a = \frac{1}{4}, b = 0, c = \frac{3}{4}$

(4) $a = \frac{3}{4}, b = \frac{1}{4}, c = 0$

---

68. Find the Laplace transform of the function

$f(t) = E \sin \omega t, \quad 0 < t < \pi/\omega$

$= 0, \quad \pi/\omega < t < 2\pi/\omega$

(1) $\dfrac{E\omega^2}{(1+e^{-\pi s/\omega})(s^2+\omega^2)}$ (2) $\dfrac{E\omega}{(1-e^{-\pi s/\omega})(s^2+\omega^2)}$

(3) $\dfrac{E^2\omega}{(1-e^{-\pi s/\omega})(s^2-\omega^2)}$ (4) $\dfrac{E\omega^2}{(1-e^{-\pi s/\omega})(s^2-\omega^2)}$

---

69. The solution of Lagrange's equation $y = xp^2 - \dfrac{1}{p}$, where $p = \dfrac{dy}{dx}$ is

(1) $y = \dfrac{2p^2+cp-1}{2(p-1)^2} - \dfrac{1}{p}$ (2) $y = \dfrac{2p^2+cp-1}{2(p-1)^2} + \dfrac{1}{p}$

(3) $y = \dfrac{cp^3+2p-1}{2(p-1)^2} + \dfrac{1}{p}$ (4) $y = \dfrac{cp^2+2p-1}{2(p-1)^2} - \dfrac{1}{p}$

---

70. Three cities, A, B and C are equidistant from each other. A motorist travels from A to B at 30 km/hr, from B to C at 40 km/hr, from C to A at 50 km/hr. Determine average speed.

(1) 34·5 km/hr (2) 38·3 km/hr

(3) 40 km/hr (4) 45·3 km/hr

---

71. If 'ϕ' is a scalar point function of x and z and $\vec{F} = \dfrac{\partial\phi}{\partial z}\,\vec{i} - \dfrac{\partial\phi}{\partial x}\,\vec{k}$, '$\phi$' satisfies Laplace equation, then the value of surface integral $\iint_S \nabla \times \vec{F} \cdot d\vec{S}$ is

(1) $\dfrac{\pi}{4}$ (2) $\dfrac{\pi}{2}$

(3) 0 (4) $\dfrac{3\pi}{2}$

---

72. A five figure number is formed by the digits 0, 1, 2, 3 and 4 without repetition. Find the probability that the number formed is divisible by 4.

(1) $\frac{5}{16}$ (2) 3·5 (3) $\frac{4}{5}$ (4) $\frac{1}{32}$

---

73. The solution of the differential equation $\left(\frac{d}{dx}+\frac{1}{x}\right)^2 y = \frac{1}{x^4}$ is

(1) $y = A + \frac{B}{x} + \frac{1}{2x^2}$ (2) $y = A + \frac{B}{x} + \frac{1}{x^2}$

(3) $y = A + Bx^2 + \frac{1}{2x^2}$ (4) $y = A + \frac{B}{x^2} - \frac{1}{2x}$

---

74. The probability density function of the variate X is

X :	0	1	2	3	4	5	6
p(X) :	K	3K	5K	7K	9K	11K	13K.

Find $P(3 < X \leq 6)$

(1) $-\frac{33}{49}$ (2) $\frac{3}{9}$ (3) $\frac{3}{4}$ (4) $\frac{33}{49}$

---

75. The Laplace transform of a pulse function

$$f_{(t)} = \frac{A}{t_0}, \quad 0 < t < t_0$$

$$= 0, \quad t < 0, t_0 < t$$

is

(1) $\frac{A}{t_0 s}(1 - e^{-st_0})$ (2) $\frac{A}{t_0 s}(1 + e^{-st_0})$

(3) $\frac{A}{s}(1 - e^{-st_0})$ (4) $\frac{A}{s}(1 + e^{-st_0})$

---

76. X is a normal variate with mean 30 and standard deviation 5. Find the probability that $26 \leq X \leq 40$.

(1) 0·7653 (2) 0·6735

(3) 0·5376 (4) 0·6753

---

77. The Euclidean norm and maximum absolute row sum norm of the matrix

$$A = \begin{bmatrix} 1 & 7 & -4 \\ 4 & -4 & 9 \\ 12 & -1 & 3 \end{bmatrix}$$

respectively are

(1) 18·25, 16 (2) 18·25, 12

(3) 25·18, 17 (4) 18·25, 17

---

78. Find a real root of the equation $x \log_{10} x = 1{\cdot}2$ by Regula-falsi method correct upto four decimal places.

(1) 3·7406 (2) 2·7406

(3) 1·7406 (4) 0·7406

---

79. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's 1/3rd rule.

(1) 1·3626 (2) 3·1326

(3) 2·1362 (4) 1·3662

---

80. If $f(x, y) = \frac{1}{x^2} + \frac{1}{xy} + \frac{\log x - \log y}{x^2 + y^2}$, then expression for $x\frac{\partial f}{\partial x} + y\frac{\partial f}{\partial y}$ is

(1) 2f (2) – 2f

(3) 4f (4) – 6f

सूचना — (पृष्ठ 1 वरून पुढे.....)

(9) प्रश्नपुस्तिकेमध्ये विहित केलेल्या विशिष्ट जागीच कच्चे काम (रफ वर्क) करावे. प्रश्नपुस्तिकेव्यतिरिक्त उत्तरपत्रिकेवर वा इतर कागदावर कच्चे काम केल्यास ते कॉपी करण्याच्या उद्देशाने केले आहे, असे मानले जाईल व त्यानुसार उमेदवारावर शासनाने जारी केलेल्या "परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचे अधिनियम-82" यातील तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.

(10) सदर प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपल्यानंतर उमेदवाराला ही प्रश्नपुस्तिका स्वत: बरोबर परीक्षाकक्षाबाहेर घेऊन जाण्यास परवानगी आहे. **मात्र परीक्षाकक्षाबाहेर जाण्यापूर्वी उमेदवाराने आपल्या उत्तरपत्रिकेचा भाग-1 समवेक्षकाकडे न विसरता परत करणे आवश्यक आहे.**

नमुना प्रश्न

Pick out the correct word to fill in the blank :

Q.No. 201. I congratulate you _____ your grand success.

(1) for (2) at

(3) on (4) about

ह्या प्रश्नाचे योग्य उत्तर "(3) on" असे आहे. त्यामुळे या प्रश्नाचे उत्तर "(3)" होईल. यास्तव खालीलप्रमाणे प्रश्न क्र. 201 समोरील उत्तर-क्रमांक "③" हे वर्तुळ पूर्णपणे छायांकित करून दाखविणे आवश्यक आहे.

प्र.क्र. 201. ① ② ● ④

अशा पद्धतीने प्रस्तुत प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाचा तुमचा उत्तरक्रमांक हा तुम्हाला स्वतंत्ररीत्या पुरविलेल्या उत्तरपत्रिकेवरील त्या त्या प्रश्नक्रमांकासमोरील संबंधित वर्तुळ पूर्णपणे छायांकित करून दाखवावा. **ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.**

कच्च्या कामासाठी जागा/SPACE FOR ROUGH WORK