DO NOT OPEN THE SEAL OF THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

PW : № 771263

JE(C+E)-2009/I

PAPER I

प्रश्नपत्र I

Test Form No.
टेस्ट फार्म सं.
394 01 9

Time Allowed : 2 Hours
निर्धारित समय : 2 घंटे

Maximum Marks : 200
अधिकतम अंक : 200

Read the following instructions carefully before you begin to answer the questions.
This booklet contains questions in English as well as in Hindi.
प्रश्नों के उत्तर देने से पहले नीचे लिखे अनुदेशों को ध्यान से पढ़ लें ।
इस पुस्तिका में प्रश्न अंग्रेजी तथा हिन्दी दोनों में दिये गये हैं ।

INSTRUCTIONS TO CANDIDATES

1. This Booklet contains 100 questions in all comprising the following two tests :
   Test (i) General Awareness *(25 Questions)*
   Test (ii) (A) General Engineering (Civil and Structural) *(75 Questions)*
   OR
   Test (ii) (B) General Engineering (Electrical and Mechanical) *(75 Questions)*
2. Test (i) (General Awareness) is compulsory for all the candidates. Candidates are required to attempt *either* Test-(ii) (A) *or* Test-(ii) (B) as per option in the application form given by the candidates failing which, you will be awarded 'ZERO' mark.
3. All questions are compulsory and carry equal marks.
4. Before you start to answer the questions you must check up this booklet and ensure that it contains all the pages (1-48) and see that no page is missing or repeated. If you find any defect in this booklet, you must get it replaced *immediately*.
5. *There will NOT be any negative marking for wrong answers.*
6. You will be supplied the Answer Sheet separately by the Invigilator. Before you actually start answering the questions, you must complete the details of *Ticket Number, Roll Number, Test Form Number* and *Stream* i.e. Civil and Structural OR Electrical and Mechanical etc., on Side-I of the Answer Sheet carefully. You must also put your signatures on the Answer Sheet at the prescribed place before you start answering the questions. These instructions must be fully complied with failing which your Answer Sheet will not be evaluated and you will be awarded 'ZERO' mark. A machine will read the coded information in the OMR Answer-Sheet. In case the information is incomplete/different from the information given in the application form, the candidature of such candidate will be treated as cancelled.
7. Answers must be shown by completely blackening the corresponding rectangles on Side-II of the Answer Sheet against the relevant question number by HB pencil only. Answers which are *not* shown by HB pencil will *not* be awarded any mark.
8. The Answer Sheet must be handed over to the Invigilator before you leave the Examination Hall.
9. Failure to comply with any of the above instructions will render a candidate liable to such action/penalty as may be deemed fit.
10. The manner in which the different questions are to be answered has been explained at the back of this Booklet (Page No. 48), which you should read carefully before actually answering the questions.
11. Answer the questions as quickly and as carefully as you can. Some questions may be difficult and others easy. Do not spend too much time on any question.
12. No rough work is to be done on the Answer Sheet. Space for rough work has been provided below the questions in Test (ii) of this booklet.

उम्मीदवारों के लिए अनुदेश

1. इस पुस्तिका में कुल 100 प्रश्न हैं, जिनमें निम्नलिखित दो परीक्षण शामिल हैं :
   परीक्षण (i) सामान्य जानकारी *(25 प्रश्न)*
   परीक्षण (ii) (क) सामान्य इंजीनियरी (सिविल एवं संरचनात्मक) *(75 प्रश्न)*
   अथवा
   परीक्षण (ii) (ख) सामान्य इंजीनियरी (वैद्युत एवं यांत्रिक) *(75 प्रश्न)*
2. परीक्षण (i) सामान्य जानकारी सभी उम्मीदवारों के लिए अनिवार्य है । उम्मीदवारों को आवेदन-पत्र में दिए विकल्प के अनुसार *या* तो परीक्षण (ii) (क) या परीक्षण (ii) (ख) को हल करना होगा, अन्यथा आपको 'शून्य' अंक दिया जाएगा ।
3. सभी प्रश्न अनिवार्य हैं तथा सबके बराबर अंक है ।
4. प्रश्नों के उत्तर देने से पहले आप इस पुस्तिका को जांच करके देख लें कि इसमें पूरे पृष्ठ (1-48) हैं तथा कोई पृष्ठ कम या दुबारा तो नहीं आ गया है । यदि आप इस पुस्तिका में कोई त्रुटि पाएँ तो *तत्काल* इसके बदले दूसरी पुस्तिका ले लें ।
5. *गलत उत्तरों के लिये कोई नकारात्मक अंकन नहीं होगा ।*
6. निरीक्षक द्वारा आपको उत्तर-पत्रिका अलग से दी जाएगी । प्रश्नों के उत्तर वास्तव में शुरू करने से पहले आप उत्तर-पत्रिका के Side-I में अपना *टिकट नम्बर, रोल नम्बर, टेस्ट फार्म संख्या* तथा *विषय* अर्थात् सिविल एवं संरचनात्मक या वैद्युत एवं यांत्रिक आदि अवश्य लिखें । प्रश्नों के उत्तर देने से पहले उत्तर-पुस्तिका पर निर्धारित स्थान में आप अपने हस्ताक्षर भी अवश्य करें । उपर्युक्त अनुदेशों का पूरी तरह अनुपालन किया जाए अन्यथा आपकी उत्तर-पत्रिका को जांचा नहीं जाएगा और शून्य अंक दिया जाएगा । ओ.एम.आर. उत्तर-पत्रिका में भरी गई कूट सूचना को एक मशीन पढ़ेगी । यदि सूचना अपूर्ण है अथवा आवेदन प्रपत्र में दी गई सूचना से भिन्न है, तो ऐसे अभ्यर्थी की अभ्यर्थिता निरस्त समझी जाएगी ।
7. उत्तर-पत्रिका में सभी उत्तर Side-II में प्रश्न संख्या के सामने दिये गये सम्बन्धित आयताकार खानों को HB पेंसिल से पूरी तरह काला करके दिखायें । जो आयताकार खाने HB पेंसिल से *नहीं* भरे जायेंगे उनके लिए कोई अंक *नहीं* दिया जायेगा ।
8. परीक्षा-भवन छोड़ने से पहले परीक्षार्थी को उत्तर-पत्रिका निरीक्षक के हवाले कर देनी चाहिए ।
9. ऊपर के अनुदेशों में से किसी एक का भी पालन न करने पर उम्मीदवार पर विवेकानुसार कार्यवाही की जा सकती है या दण्ड दिया जा सकता है ।
10. विभिन्न प्रश्नों के उत्तर देने की विधि इस पुस्तिका के पीछे (पृष्ठ संख्या 48) में छपे हुए निर्देशों में दी गई है; इसे आप प्रश्नों के उत्तर देने से पहले ध्यानपूर्वक पढ़ लें ।
11. प्रश्नों के उत्तर जितनी जल्दी हो सके तथा ध्यानपूर्वक दें । कुछ प्रश्न आसान तथा कुछ कठिन है । किसी एक प्रश्न पर बहुत अधिक समय न लगाएँ ।
12. कोई रफ कार्य उत्तर-पत्रिका पर नहीं करना है । रफ कार्य के लिए स्थान इसी पुस्तिका के परीक्षण (ii) के प्रश्नों के नीचे दिया गया है ।

इस पुस्तिका की सील तब तक न खोलें जब तक कहा न जाए ।

SEAL

फाईनल मास्टर 1/10/2010 3/11/2010 - CPWD

TEST (i)

GENERAL AWARENESS

1. The present Governor of RBI is

   (A) K.C. Reddy

   (B) D. Subbarao

   (C) Kiran Kamik

   (D) Deepak Parekh

2. Who has been adjudged as Businessperson of the Year, 2008 by The Times of India Survey ?

   (A) Mukesh Ambani

   (B) Rahul Bajaj

   (C) Aditya Birla

   (D) Ratan Tata

3. What will happen to the temperature of a closed room if the refrigerator inside is switched ON with its door kept open ?

   (A) It will fall

   (B) It will rise

   (C) It will be constant

   (D) It will fluctuate

4. The Sun and the Moon appear elliptical near the horizon due to

   (A) interference

   (B) illusion

   (C) diffraction

   (D) refraction

5. Who is the author of the book 'Q & A' on which the film 'Slumdog Millionaire' is based ?

   (A) Vikas Swarup

   (B) Salman Rushdie

   (C) Taslima Nasreen

   (D) Anita Sobd

6. Which one of the following cricketers had been awarded the 'Rajiv Gandhi Khel Ratna Award' (2007) ?

   (A) Sachin Tendulkar

   (B) M.S. Dhoni

   (C) Saurav Ganguly

   (D) Anil Kumble

7. Which one of the following Presidents of India has taken a 30-minute sortie in a Sukhoi fighter plane of the Indian Air Force ?

   (A) A.P.J. Abdul Kalam

   (B) S. Radhakrishnan

   (C) V.V. Giri

   (D) R. Venkataraman

8. The famous Kohinoor diamond was presented to Humayun by the king of
   (A) Persia
   (B) Gwalior
   (C) Kandahar
   (D) Marwar

9. The first Muslim female ruler of Delhi was,
   (A) Chand Bibi
   (B) Nur Jehan
   (C) Razia Sultana
   (D) Jehan Ara

10. The Golden Quadrilateral Project is related to
   (A) Waterways
   (B) Airways
   (C) Roadways
   (D) Railways

11. Chandragupta II got the title of 'Vikramaditya' meaning equal to
   (A) Sun God
   (B) Agni
   (C) Vayu
   (D) Indra

12. The main reason for the execution of Guru Arjun Singh was that
   (A) he was conspiring against Mughals
   (B) he refused to embrace Islam
   (C) he had blessed Prince Khusro who had revolted against Jahangir
   (D) Jahangir did not like him

13. The shifting cultivation in Assam is referred to as
   (A) Valra
   (B) Podu
   (C) Bewar
   (D) Jhum

14. Large destructive sea waves resulting from an earthquake are called
   (A) Tidal waves
   (B) Subduction
   (C) Currents
   (D) Tsunami

15. Transpiration would be minimum when there is
   (A) bright sunlight
   (B) high humidity
   (C) wind blowing
   (D) high temperature

16. Without using soil, plants can also be grown in
   (A) distilled water
   (B) salt solution
   (C) sugar solution
   (D) nutrient solution

17. Tamil Nadu remains dry during the South-West monsoon period because
   (A) it lies in the rain shadow region
   (B) of the presence of Eastern Ghats
   (C) of Palghat and Thalghat passes
   (D) of wider coastal plains

34. When turning long shaft on a lathe, its bending can be prevented by

(A) running the shaft at low speed

(B) using high speed

(C) using sturdy machine

(D) using steady rest

35. The operation of sharpening a grinding wheel is called

(A) trueing

(B) dressing

(C) aligning

(D) balancing

36. A universal dividing head is used to perform a milling operation by

(A) plain indexing

(B) direct indexing

(C) differential indexing

(D) compound indexing

37. In grinding operation, for grinding harder material

(A) coarser grain size is used

(B) fine grain size is used

(C) medium grain size is used

(D) any grain size may be used

38. A cantilever beam is deflected by d due to load P. If load is doubled, then deflection compared to earlier case will be changed by a factor of

(A) 2

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

(C) $\frac{1}{8}$

(D) 8

39. Principal plane is one which carries

(A) no shear stress

(B) maximum shear stress

(C) no normal stress

(D) maximum resultant of stresses

40. Hooke's law holds good upto

(A) yield point

(B) limit of proportionality

(C) breaking point

(D) elastic limit

41. The percentage reduction in area in case of cast iron when it is subjected to tensile test is of the order of

(A) 0%

(B) 10%

(C) 20%

(D) 25%

SPACE FOR ROUGH WORK

42. Which of the following machines does ***not*** require quick return mechanism ?

(A) Slotter
(B) Planer
(C) Shaper
(D) Broaching

43. Milling machine is classified as horizontal or vertical type, depending on the position of

(A) spindle
(B) work piece
(C) milling cutter
(D) work table or bed

44. In which of the following operations on lathe, will the spindle speed be minimum ?

(A) Knurling
(B) Fine finishing
(C) Taper turning
(D) Thread cutting

45. For drilling operation, the cylindrical job should always be clamped on a

(A) collet
(B) socket
(C) jaw
(D) V-block

46. Which of the following is ***not*** a casting process ?

(A) Carthias process
(B) Extrusion
(C) Semi-centrifuge method
(D) Slush process

47. In arc welding, arc is created between the electrode and work by

(A) flow of current
(B) voltage
(C) material characteristics
(D) contact resistance

48. Oxygen to acetylene ratio in case of neutral flame is

(A) 0·8 : 1·0
(B) 1 : 1
(C) 1·2 : 1
(D) 2 : 1

49. The taper provided on pattern for its easy and clean withdrawal from the mould is called

(A) taper allowance
(B) draft allowance
(C) distortion allowance
(D) pattern allowance

SPACE FOR ROUGH WORK

50. An ideal flow of any fluid must satisfy
(A) Pascal's law
(B) Newton's law of viscosity
(C) Boundary layer theory
(D) Continuity equation $a_1V_1 = a_2V_2$

51. The flow which neglects changes in a transverse direction is known as
(A) one-dimensional flow
(B) uniform flow
(C) steady flow
(D) turbulent flow

52. For the same compression ratio
(A) Otto cycle is more efficient than the Diesel cycle
(B) Diesel cycle is more efficient than the Otto cycle
(C) both Otto and Diesel cycles are equally efficient
(D) compression ratio has nothing to do with efficiency

53. Water tube boilers are those in which
(A) flue gases pass through tubes and water around it
(B) water passes through the tubes
(C) work is done during adiabatic expansion
(D) there is change in enthalpy

54. Pitot tube is used for the measurement of
(A) pressure
(B) flow
(C) velocity
(D) discharge

55. In a centrifugal pump, the liquid enters the pump
(A) at the top
(B) at the bottom
(C) at the centre
(D) None of the above

56. In reaction turbine
(A) kinetic energy is appreciable as the fluid leaves the runner and enters the draft tube
(B) the vanes are partly filled
(C) total energy of fluid is converted to kinetic energy in the runner
(D) it is exposed to the atmosphere

57. Equation of continuity of flow is based on the principle of conservation of
(A) mass
(B) force
(C) momentum
(D) energy

SPACE FOR ROUGH WORK

58. First law of thermodynamics furnishes the relationship between

(A) heat and work.

(B) heat, work and properties of the system

(C) various properties of the system

(D) various thermodynamic processes

59. Which instrument has the lowest resistance ?

(A) Ammeter

(B) Voltmeter

(C) Megger

(D) Frequency-meter

60. The moving coil in a dynamometer wattmeter is connected

(A) in series with the fixed coil

(B) across the supply

(C) in series with the load

(D) Any one of the above

61. The power factor will be leading in case of

(A) Dielectric heating

(B) Resistance heating

(C) Induction heating

(D) All the above

62. Triple point of a pure substance is a point at which

(A) liquid and vapour exist together

(B) solid and liquid exist together

(C) solid and vapour exist together

(D) solid, liquid and vapour phases exist together

63. Which of the following is ***not*** an internal combustion engine ?

(A) 2-stroke petrol engine

(B) 4-stroke petrol engine

(C) Diesel engine

(D) Steam engine

64. Change of entropy depends upon

(A) change of mass

(B) change of temperature

(C) change of specific heat

(D) change of heat

65. Thermal plant works on

(A) Carnot cycle

(B) Joule cycle

(C) Rankine cycle

(D) All the above

SPACE FOR ROUGH WORK

66. The rating of fuse is expressed in terms of

(A) amperes

(B) volts

(C) VAR

(D) KVA

67. By burden of the relay we mean

(A) volt-ampere rating of relay

(B) current rating of relay

(C) voltage rating of relay

(D) watt rating of relay

68. Reactance relays are employed for phase fault in

(A) long line

(B) medium line

(C) short line

(D) Any of these

69. Earth fault relays ate

(A) directional relays

(B) non-directional relays

(C) short operate time relays

(D) long operate time relays

70. The recovery voltage will be maximum for power factor of

(A) zero

(B) 0·5

(C) 0·707

(D) unity

71. An air blast circuit breaker is usually employed for

(A) instantaneous voltage

(B) intermittent duty

(C) repeated duty

(D) short duty

72. The ratio of line-to-line capacitance and line-to-neutral capacitance is

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

(B) $\frac{1}{4}$

(C) 2

(D) 4

73. The material commonly used for sheaths of underground cable is

(A) lead

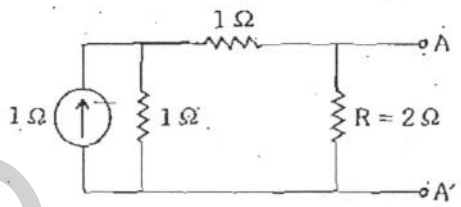
(B) steel

(C) rubber

(D) copper

SPACE FOR ROUGH WORK

96. In the figure shown below, if we connect a source of 2 V, with internal resistance of 1 Ω at AA′ with positive terminal at A, then current through R is



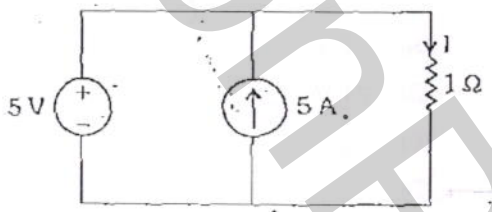
(A) 2 A

(B) 1·66 A

(C) 1 A

(D) 0·625 A

97. The value of current I flowing in the 1 Ω resistor in the circuit shown in the figure below will be



(A) 10 A

(B) 6 A

(C) 5 A

(D) zero

98. Specific resistance of a conductor depends upon

(A) Dimension of the conductor

(B) Composition of conductor material

(C) Resistance of the conductor

(D) Both (A) and (B)

99. Superposition theorem is essentially based on the concept of

(A) Reciprocity

(B) Linearity

(C) Duality

(D) Non-linearity

100. The curve representing Ohm's law is

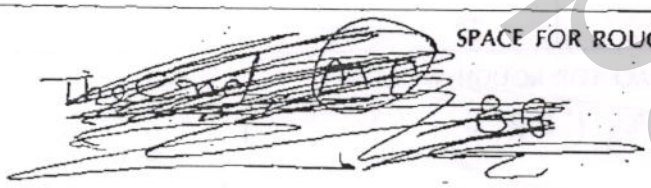
(A) Linear

(B) Hyperbolic

(C) Parabolic

(D) Triangular

SPACE FOR ROUGH WORK



90. A 4-pole generator with 16 coils has a two layer lap winding. The pole pitch is

(A) 32

(B) 16

(C) 8

(D) 4

91. In an R-L-C circuit, susceptance is equal to

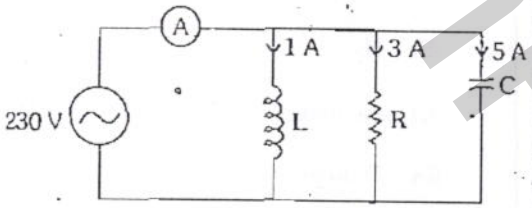
(A) $\frac{1}{X}$

(B) $\frac{1}{R}$

(C) $\frac{R}{Z^2}$

(D) $\frac{X}{Z^2}$

92. The current read by the ammeter A in the AC circuit shown in following figure is



(A) 9 A

(B) 5 A

(C) 3 A

(D) 1 A

93. Two coupled coils with $L_1 = L_2 = 0{\cdot}6$ H have a coupling coefficient of K = 0·8. The turn ratio $\frac{N_1}{N_2}$ is

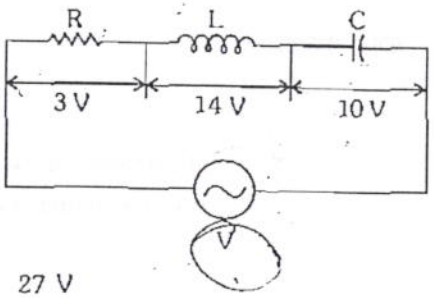
(A) 4

(B) 2

(C) 1

(D) 0·5

94. The voltage across the various elements are marked, as shown in the figure given below. The input voltage is



(A) 27 V

(B) 24 V

(C) 10 V

(D) 5 V

95. The principle of dynamically induced emf is utilised in a

(A) Choke

(B) Transformer

(C) Thermocouple

(D) Generator

SPACE FOR ROUGH WORK

82. The angle between induced emf and terminal voltage on no-load for a single phase alternator is

(A) 180°

(B) 90°

(C) 0°

(D) 270°

83. A salient pole synchronous generator connected to an infinite bus will deliver maximum power at a power angle of

(A) $\delta = 0$

(B) $\delta = 90°$

(C) $\delta = 45°$

(D) $\delta = 30°$

84. Starting torque of synchronous motor is

(A) very low

(B) zero

(C) very high

(D) half-full load torque

85. If a 500 KVA, 200 Hz transformer is operated at 50 Hz, its KVA rating will be

(A) 2000 KVA

(B) 125 KVA

(C) 250 KVA

(D) 1000 KVA

86. The efficiency of a 100 KVA transformer is 0·98 at full as well as half load. For this transformer at full load the copper loss

(A) is less than core loss

(B) is equal to core loss

(C) is more than core loss

(D) All the above

87. Which of the following will improve the mutual coupling between primary and secondary circuit ?

(A) Transformer oil of high breakdown voltage

(B) High reluctance magnetic core

(C) Winding material of high resistivity

(D) Low reluctance magnetic core

88. High leakage transformers are of

(A) small voltage-ampere rating

(B) high voltage-ampere rating

(C) high voltage rating

(D) low voltage rating

89. The power factor at which transformer operates

(A) is unity

(B) is 0·8 lag

(C) is 0·8 lead

(D) depends upon the power factor of the load

SPACE FOR ROUGH WORK

74. The permissible variation of frequency in power system P_s is

(A) ± 1%

(B) ± 3%

(C) ± 5%

(D) ± 10%

75. For cooling of large size generators hydrogen is used because

(A) it offers reduced fire risk

(B) it is light in weight

(C) it is of high thermal conductivity

(D) All the above

76. The connected load of a consumer is 2 kW and his maximum demand is 1·5 kW. The demand factor of the consumer is

(A) 0·75

(B) 0·375

(C) 1·33

(D) 1

77. To meet the reactive power requirements at load centres usually

(A) shunt capacitors are used

(B) series capacitors are used

(C) shunt reactors are used

(D) tap changing transformers are used

78. A centre zero ammeter connected in the rotor circuit of a 6-pole, 50 Hz induction motor makes 30 oscillations in one minute. The rotor speed is

(A) 670 rpm

(B) 990 rpm

(C) 1010 rpm

(D) 1030 rpm

79. The starting torque of a 3-phase induction motor varies as

(A) V^2

(B) V

(C) $\sqrt{V}$

(D) $\frac{1}{V}$

80. In a 3-phase induction motor, the mechanical power developed, in terms of air gap power P_g is

(A) $(1 - S)\, P_g$

(B) $P_g\, S$

(C) $\frac{P_g}{1 - S}$

(D) $\frac{P_g}{S}$

81. The negative phase sequence in a 3-phase synchronous motor exists when the motor is

(A) underloaded

(B) overloaded

(C) supplied with unbalanced voltage

(D) hot

SPACE FOR ROUGH WORK

7. (a) Describe about Francis turbine with respect to its component parts, construction and operation. 20

(b) Establish the ratio of forces exerted by a water jet when it is made to strike—

(i) a stationary flat plate held normal to it;

(ii) a flat plate moving in the direction of jet at one-third the velocity of jet;

(iii) a series of flat plates mounted on a wheel and moving at one-third the velocity of jet. 10

8. (a) Make a comparison of Otto, Diesel and Dual combustion cycle for—

(i) maximum compression ratio and same heat input;

(ii) constant maximum pressure and same heat input;

(iii) same maximum temperature and pressure. 20

(b) Explain the function and working of a simple carburetor with a neat sketch. 10

9. (a) What are the advantages of using taper turning attachment in lathe? 5

(b) Explain cutting speed, feed and depth of cut in case of lathe. 10

(c) With a neat sketch, show the details of a tail-stock. 15

10. (a) What are the various operations performed on milling machine? Explain plain milling, face milling and side milling. 15

(b) Explain tool head of a shaper with the help of a neat sketch. 15

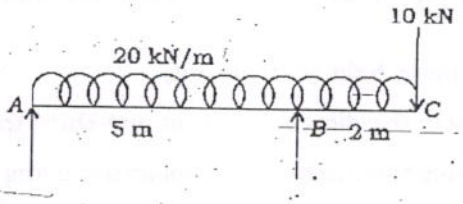
11. (a) Explain the function of Hartnell governor. 5

(b) With the help of a neat sketch, describe crank and slotted lever mechanism. 10

(c) The external and internal radii of a friction plate of a single clutch are 120 mm and 60 mm, respectively. The total axial thrust with which the friction surfaces are held together is 1500 N. For uniform wear, find the maximum, minimum and average pressure on the contact surfaces. 15

12. *(a)* What are the assumptions of Euler's theory? 5

(b) Draw the BM and SF diagrams for the overhanging beam carrying loads as shown in the figure. Mark the values of the principal ordinates and locate the point of contra-flexure. 10



(c) Three vertical rods equal in length and each 12 mm in diameter are equispaced in a vertical plane and together support a load of 10000 N, the rods being so adjusted as to share the load equally. If now an additional load of 10000 N be added, determine the stress in each rod. The middle rod is of copper and the outer rods are of steel. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 1 \times 10^5$ N/mm^2. 15

SECTION II
(Mechanical)

7. (a) What do you understand by characteristic curves of centrifugal pump ? Draw the figure. 10

(b) What do you mean by specific speed of a turbine ? Explain. 5

(c) What will be the force exerted by

(i) direct impact of a jet on a stationary flat plate ?

(ii) oblique impact of a jet on a stationary flat plate ?

Explain with neat sketches. 15

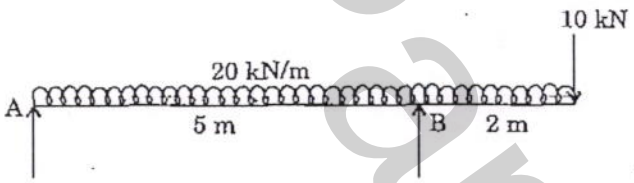
8. (a) Show that the air standard efficiency of Otto cycle depends on compression ratio only. 15

(b) Describe working of a simple plain tube carburettor with the help of a neat sketch. 15

9. (a) A load of 270 kN is applied on a short concrete column 250 mm × 250 mm. The column is reinforced with 8 bars of 16 mm diameter. If the modulus of elasticity for steel is 18 times that of concrete, find the stresses in concrete and steel.
If the stress in concrete shall not exceed 4 N/mm^2, find the area of steel required so that the column may support a load of 400 kN. 10

(b) Draw the B.M. and S.F. diagrams for the overhanging beam carrying loads as shown in figure given below.

Mark the values of principal ordinates and locate the point of contraflexure. 20



10. (a) Define inversion. Write its properties and importance. 15

(b) A capstan and a rope are used in a railway goods yard for moving trucks. The capstan runs at 50 r.p.m. The rope from the line of trucks makes 2·75 turns around the capstan at a radius of 20 cm and the free end of the rope is pulled with a force of 147·15 N. Determine the pull on the trucks, the power taken by the trucks, and the power supplied by the capstan. Take $\mu = 0{\cdot}25$. 15

11. (a) Define and explain with proper sketches, the following lathe operations : 15

(i) Grooving

(ii) Chamfering

(b) Explain Taper turning on lathe in detail. 10

(c) Determine the angle at which the compound rest would be swivelled for cutting a taper on a workpiece having a length of 150 mm and outside diameter 80 mm. The smallest diameter on the tapered end of the rod should be 50 mm and the required length of the tapered portion is 80 mm. 5

12. (a) Explain centreless grinders. Give sketches for external centreless grinding and write about (i) through feed (ii) infeed and (iii) end feed. 20

(b) Calculate the time required to drill a 25 mm diameter hole in a workpiece having thickness of 60 mm to the complete depth. The cutting speed is 14 m/min and feed is 0·3 mm/rev. Assume length of approach and overtravel as 5 mm. 10

SECTION II
(Mechanical)

7. (a) List out the merits and demerits of water tube boilers over fire tube boilers. 10

   (b) With the help of neat sketches explain the working of a four-stroke diesel engine. 20

8. (a) Explain different types of patterns used in foundry. 15

   (b) Explain any five different operations that can be carried out in lathe. 15

9. (a) Give the classification of milling machines. Also explain up and down milling. 10

   (b) Explain with figure the quick return mechanism used in shapers. 10

   (c) Explain various parameters used in selection of grinding wheel. 10

10. (a) Derive Bernoulli's equation from Euler's equation. 15

    (b) Define the following : 15

    Density, Newton's law of viscosity, Compressibility, Surface tension, and Pressure.

11. (a) Explain the salient features and behaviour of stress-strain curve for a tensile material with the figure. 10

    (b) A rectangular beam with depth 150 mm and width 100 mm is subjected to a maximum bending moment of 300 kNm. Determine : maximum stress in the beam, radius of curvature when the bending is maximum and bending stress at a distance of 40 mm from the top surface of the beam. E for beam is 200 GPa. 10

    (c) A solid circular shaft transmits 80 kW of power while turning 200 revolutions per minute. Work out suitable diameter of the shaft if the shear is limited to 60 MN/m^2 and the twist in the shaft is not to exceed 1 degree in 2 metres of length. Assume uniform turning moment and take modulus of rigidity of the shaft material $C = 100\ GN/m^2$. 10

12. (a) Write about Grubler's criteria for planar mechanism. 5

    (b) With neat sketch explain gear tooth nomenclature. 15

    (c) Explain : 10

    (i) Turning movement diagram

    (ii) Flywheel of a punch press

SECTION II
(Mechanical)

7. (a) With the help of figure, explain the working of Babcock and Wilcox boiler. 15

   (b) List out the differences between : 15

   (i) Two stroke and Four stroke IC engines

   (ii) Petrol and Diesel engines

8. (a) Explain different properties of moulding sand. 10

   (b) With the help of figure explain different types of gas flames produced in oxy-acetylene welding process. 5

   (c) With the help of neat figure explain the different nomenclature of twisted drill bit used in drilling machine. 15

9. (a) What is indexing in milling machine ? Explain the procedure used in compound indexing. 10

   (b) Mention at least five differences between shaper and slotting machines. 10

   (c) With the help of figure explain centerless grinding process. 10

10. (a) Derive the continuity equation in differential form. 10

    (b) Calculate the maximum allowable discharge of water through a venturimeter throat 5 cm, fitted in a 10 cm diameter line with its inlet at an open channel. Assume $C_d = 0.95$. 10

    (c) Explain the performance parameters of centrifugal pumps. 10

11. (a) A steel bar of rectangular section 50 mm × 30 mm and length 1·5 m is subjected to a gradually applied load of 150 kN. Find the strain energy stored in the bar. If the elastic limit of the material of the bar is 150 N/mm^2, proceed to determine the proof resilience and modulus of resilience. Take $E = 2 \times 10^5$ N/mm^2. 7

    (b) A timber beam of rectangular section is to support a load of 20 kN uniformly distributed over a span of 4 metres. If the depth of the section is to be twice the breadth and the stress in the timber is not to exceed 7 MPa, find the dimensions of the cross-section. 8

    (c) Derive the torsion equation for a shaft subjected to pure torsion. 15

12. (a) Explain : 15

    (i) Watt governor

    (ii) Porter governor

    (b) Explain about helical and bevel gears with applications. 10

    (c) Explain the Ackermann steering gear mecbanism. 5

1. (a) Explain Tempering process and its classification (Austempering/Isothermal quenching and Martempering/Stepped quenching). 15

(b) With the help of neat sketch describe arc welding with coated electrode in detail. 15

2. (a) The total tension on the two sides of a belt connecting two pulleys is 2 kN. The minimum angle of embrace of the belt is 150° and coefficient of friction between the belt and the pulley rim is 0.25. Determine the value of the tension on both the tight and the slack side of the belt. Also calculate the power transmitted if the speed of the belt is 600 m/minute. 15

(b) Draw roller follower – cam mechanism and describe the terminology

(i) base circle

(ii) pitch curve

(iii) prime circle

(iv) pressure angle and pitch point. 15

खण्ड II
(यांत्रिक)

7. (a) किसी तंत्र में गैस ऊष्मा लेती है जो 2 bar के अचर दाब के प्रति प्रसार पैदा करती है । तंत्र में एक विलोड़क 100 W का प्रयोग करने वाली एक विद्युत मोटर द्वारा चलाया जाता है । 4 kJ ऊष्मा की पूर्ति करने पर तंत्र के आयतन में 30 सेकंड में 0.06 m^3 की वृद्धि होती है । तंत्र की ऊर्जा में निवल परिवर्तन का आकलन कीजिए । 15

(b) एक रेफ्रिजरेटर की प्रशीतन क्षमता 12,000 kJ/h होती है, जब शक्ति निवेश 0.75 kW हो; उसके संधारित्र में निष्पादकता गुणांक और ऊष्मा अंतरण दर kJ/h में ज्ञात कीजिए । 15

8. (a) वायु मानक चक्र क्या है ? वायु मानक दक्षता की परिभाषा कीजिए और वायु मानक चक्र में निहित कल्पनाओं का उल्लेख कीजिए । 15

(b) IC इंजनों में शीतलन प्रणाली के उद्देश्य की व्याख्या कीजिए । विभिन्न प्रकार की शीतलन प्रणालियों का संक्षेप में उल्लेख भी कीजिए । 15

9. (a) मैनोमीटर (दाबांतरमापी) किस सिद्धांत पर काम करत.. है ? उसके विभिन्न प्रकारों की व्याख्या कीजिए, संक्षेप में उनके प्रयोग सहित । 15

(b) वर्नूली प्रमेय क्या है ? उसकी कल्पनाओं का भी उल्लेख कीजिए ।

एक नली के व्यास खंड 1 तथा 2 पर क्रमशः 10 cm और 15 cm हैं । नली से विसर्जन ज्ञात कीजिए, यदि खंड 1 पर नली से जल 5 m/sec के वेग से प्रवाह कर रहा है । खंड 2 पर वेग ज्ञात कीजिए । 15

10. (a) भीतरी व्यास 125 mm और बाह्य व्यास 250 mm वाले एक मोटे सिलिंडर पर 50 N/mm^2 का आंतरिक तरल दाब डाला गया है । परिधिक प्रतिबल की अधिकतम और न्यूनतम तीव्रताएँ ज्ञात कीजिए और परिच्छेद के गिर्द परिधिक प्रतिबल तीव्रता तथा त्रिज्य दाब तीव्रता के वितरण का रेखाचित्र बनाइए । 15

(b) अधिकतम बल-आघूर्ण ज्ञात कीजिए जो 200 mm व्यास की शैफ़्ट पर निरापद डाला जा सकता है, यदि 5 m लंबाई के लिए अनुमत ऐंठन कोण 1° है और अनुमत अपरूपण प्रतिबल 45 N/mm^2 है । दृढ़ता मापांक = 0.8×10^5 45 N/mm^2 लें । 15

PART - C

GENERAL ENGINEERING (Mechanical)

1. (a) What is Law of Machine ? Also find out relationship between Load, Mechanical Advantage and Efficiency. 15

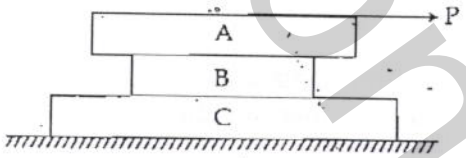
(b) Explain the different design considerations, on which the design of Disc clutch is based. Also find out the relationship for Torque capacity of the Clutch, in each case. 15

(c) Find out the condition for Constant velocity ratio between two Gear wheels. 15

(d) What is Hydrodynamic Bearing ? Explain Hydrodynamic lubrication theory, with assumptions and variables involved. 15

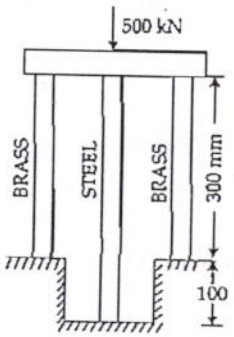
2. (a) A body is dropped from rest at height h. It covers a distance of $^{9h}/_{25}$ in the last second. Determine the height h. Take $g = 10\ m/s^2$. 15

(b) Consider a system of three blocks resting upon one another as shown below. The block A weighs 150 N, B weighs 50 N and C weighs 100 N. The coefficients of friction are 0.3 between A and B, 0.2 between B and C and 0.1 between C and the ground. Determine the least horizontal force P necessary to start motion of any part of the system. 15



(c) A solid shaft of 80 mm diameter is transmitting [illegible]. Calculate the maximum shear stress induced in [illegible] twist in degrees for a length of 6 m. Take [illegible] material $= 8 \times 10^4\ N/mm^2$. 15

(d) A steel rod of cross sectional area 2000 mm^2 and [illegible] sectional area of 1200 mm^2 together support a [illegible] following figure. Find the stresses in the rods. Take [illegible] and E for Brass $= 1 \times 10^5\ N/mm^2$. 15



3. (a) 0.3 kg of Nitrogen gas at 100 kPa and 40°C is contained in a cylinder. The piston is moved compressing Nitrogen until the pressure becomes 1 MPa and temperature becomes 160°C. The work done during the process is 30 kJ. Calculate the heat transferred from Nitrogen to the surroundings. C_v for Nitrogen = 0.75 kJ/kg – K. 15

(b) Find the coefficient of performance and Heat transfer rate in the condenser of a refrigerator in kJ/h, which has a refrigeration capacity of 12000 kJ/h when power input is 0.75 kW. 15

(c) Determine the amount of heat, which should be supplied to 2 kg of water at 25°C to convert it into steam at 5 bar and 0.9 dry. 15

(d) Differentiate between Impulse and Reaction Steam Turbines. 15

4. (a) Showing Otto cycle on P-V and T-S diagram, find out Air standard efficiency of the cycle. 15

(b) Explain normal Combustion phenomenon in S I Engine. 15

(c) How reverse Carnot cycle can be used in achieving Refrigeration ? Explain and also find out COP of the cycle. 15

(d) What are the factors on which selection of Boiler is done ? Also, differentiate between Fire tube and Water tube Boilers. 15

5. (a) What is the Newton's law of Viscosity ? A plate 0.025 mm distant from a fixed plate, moves at 60 cm/sec and requires a force of 2 N/m^2 to maintain this speed. Determine the viscosity of the fluid between the plates. 15

(b) Differentiate between : 15

(i) Laminar and Turbulent flow

(ii) Compressible and Incompressible flow

(iii) Rotational and Irrotational flow

(c) What is the principle on which Pitot tube works ? Also, show the arrangements, adopted with Pitot tube, in order to get the velocity of flow in a pipe at any pipe. 15

(d) What are the various considerations, based on which, Turbines can be classified ? 15

6. (a) What are the important properties of Moulding sand ? 15

(b) Describing Oxy Acetylene welding process, also explain the types of flames used in it. 15

(c) What do you understand by Forging process ? Also discuss its types. 15

(d) What is Milling Operation ? Also describe differences between Up and Down Milling. 15

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Trend

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