MECHANICAL ENGINEERING

Time Allowed: 3 hours *Maximum Marks : 300*

Candidates should attempt Questions Nos. 1 and 5 which are compulsory, and any three of the remaining questions selecting at least one question from each Section.

If any data is considered insufficient, assume suitable value.

Newton may he converted to kg using the equality I kilo Newton (1 kN) = 100 kg, if found necessary.

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PAPER - I

SECTION A

1. Answer any three of the following:

(a) (i) Define pressure angle for a cam follower mechanism. Explain its importance in the design of cam profile.

(ii) A plate cam drives a radial translating follower with cycloidal motion at 1000 rpm. Rise and return strokes are each 120° with two equal dwells. Follower is retained against the cam by a compression spring with a scale of 15 N/mm. Spring is compressed by 2.5 mm in assembly to provide an initial load. For a rise of 10 mm and a follower mass of 1.8 kg, compute the radial component of the cam force and the cam shaft torque at a point located at 1000 in the ascending stroke.

(20)

(b) A machine, of mass 17 kg, is mounted on a spring having stiffness 1 N/mm. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 75 mm and a speed of 5000 rpm. Assuming the motion to be SHM, determine:

(i) amplitude of motion of the machine.

(ii) force transmitted to the ground.

Damping ratio may be taken as 0.20.

(20)

(c) (i) Under which condition of the state of stress at a point in the two dimensions, the Mohr's circle will be reduced to a point?

(ii) How much change in volume would a 100 mm side cube of steel will have when it is kept at a depth of 2 km in sea water? Assume specific gravity of sea water equal to 1.02, modulus of elasticity equal to 2.08 GPa and Poisson's ratio equal to 0.29.

(20)

(d) (i) With the help of a neat sketch, explain the following terms: Crystallographic axes, Primitives and Interfacial angles.

(ii) Compare 8CC and FCC structures.

(iii) What is solid solution? Explain with the help of neat sketches the different types of solid solutions.

(20)

2. (a) (i) Explain the concept of controlling force in connection with a centrifugal governor and state its importance in determining the stability of a centrifugal type governor.

(ii) In a spring loaded governor of Hartnell type, the mass of each ball is 1 kg. The length of the vertical arm of the bell crank ever is 100 mm and that of horizontal arm is 50mm. The distance of the fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 per cent greater than the minimum which is 360 rpm. Find initial compression of the spring and mass of the sleeve neglecting obliquity of the arms. Also find the equilibrium speed corresponding to the radius of rotation equal to 100 mm.

(30)

(b) (i) What is creep of belt in a belt drive? Explain it with the help of a neat sketch.

(ii) A leather belt 100 mm wide and 10 mm thick is transmitting power at 1000 m/min. The net driving tension is 1.8 times the tension on the slack side. If the safe permissible stress on the belt section is 1.6 N/mm^2, calculate the maximum power that can be transmitted at this speed. Assure the density of leather equal to 1000 kg/m^3.

(30)

3. (a) A steel bolt of diameter 1.8 cm passes coaxially through a copper tube of inner diameter 2 cm and outer diameter 3 cm. The length of the tube is 50 cm. Washers are placed at both ends of the tube. The bolt has threads at one end having pitch equal to 0.24 cm. The nut is turned on the bolt through 45° against the washer to tighten the assembly. Determine the stress developed in the bolt and the tube. Assume the modulus of elasticity of steel to be 2 x 10^5 N/mm^2 and modulus of elasticity of copper is half that of steel.

(20)

(b) The section of a beam is square of 10 cm side with one diagonal vertical. It is subjected to a transverse shear force of magnitude F. Determine the problem of the layer at which the transver shear stress is maximum.

(20)

(c) A solid circular steel shaft is encased in a hollow copper shaft so as to make a compound shaft. The diameter of the steel shaft is 8 cm and the outside diameter of the copper shaft is 11 cm. The compound shaft of length 2 m is subjected to an axial torque of 8 kNm. Determine the miximum shear stress in steel and copper.

Given " $G_{Steel} = 2 G_{copper} = 80$ kN/mm^2.

(20)

4. (a) Explain the method of controlling the grain size in a polycrystalline material.

(15)

(b) What do you mean by 'stellite'? What are the important properties possessed by this material? Write down the uses of stellite in the engineering applications.

(15)

(c) How are plastics broadly classified? What are the advantages and disadvantages of plastic materials?

(10)

(d) What is tempering of steel? How is it carried out? Differentiate between Cyaniciing arid Nitriding.

(20)

SECTION B

5. Answer any three of the following:

(a) What is 3-2-1 principle of location? What are the various degrees of freedom for a body in space? Distinguish between a Jig and a Fixture.

(20)

(b) What is ultrasonic machining? Draw a neat sketch showing the important parts of an ultrasonic machine, label the parts. Which materials are normally machined using ultrasonic machining?

(20)

(c) The store of an oil engine repair shop has ten items whose details are shown in Table below. Apply ABC analysis to items of store. Does it satisfy principle of ABC analysis?

(20)

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Table

Part Code	Description	Price Per Unit Rs.	Units/year
P01	Packing stud	100	100
P02	Tower bolt	200	300
P03	Hexagonal nut	50	700
P04	Bush	300	400
P05	Couplins	500	1000
P06	Big Bearings	3000	30
P07	Small Bearings	1000	100
P08	Fuel Pump	7000	500
P09	Fixture	5000	105
P10	Drill bit	60	1000

(d) (i) With a neat sketch briefly explain organization of digital computer.

(ii) Write down the general structure of a logical IF statement in modern FORTRAN language.

(iii) Differentiate between a function sub programme and sub-routine.

(20)

6. (a) What is the difference between laser welding and plasma welding ? Draw a neat sketch of a plasma torch, label the various parts.

(30)

(b) Derive an equation for the average die pressure in open die forging of a circular disc. Explain the assumptions made in deriving the equation. The solution may be found only for the sliding condition of friction.

(30)

7. (a) Four different castings are to be machined on four machines, one casting on each machine, because set—up cost and time are too high to permit a casting being worked on more than one machine. Table below shows time of machining each casting on each machine. Assign the jobs on machines and show that the problem is multi-optimal solutions. Obtain sequential solution.

Table

Casting	Machines			
	M_1	M_2	M_3	M_4
C_1	10	14	22	12
C_2	16	10	18	12
C_3	8	14	20	14
C_4	20	8	16	6

(30)

(b) Following data refers to gas pipe project:

Activity	Prede-cessor	Duration (Weeks)		
		Optimistic time, a	Most likely time, m	Pessimistic time, b
A	–	3	5	8
B	–	6	7	9
C	A	4	5	9
D	B	3	5	8
E	A	4	6	9
F	C, D	5	8	11
G	C, D, E	3	6	9
H	F	1	2	9

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(i) Construct Project network.
(ii) Find the expected duration and variance of each activity.
(iii) Find the critical path and expected project completion time.
(iv) What is the probability of completing the project on or before 30 weeks?

(30)

8. (a) What do you understand by the abbreviation HSS. Twist drills are used for making holes in machine parts, label the various features of a twist drill Used for making holes in mild steet. What are the tools used for finishing the holes ? Make neat sketches to illustrate your answers.

(30)

(b) (i) Describe steps to be followed during "Time Study".

(ii) In a turning shop, a direct time study was on a step turning. The study was conducted by an experienced industrial engineer and one inexperienced engineer. They agreed precisely on cycle, time shown in Table below, but their opinion on rating of workers was differed. The experienced engineer rated the worker 100% and the other engineer rated the worker 120%. They used 0.10 allowance fraction.

Table

Cycle Time (minutes)	Number of Times observed
21	2
25	1
30	1
33	1

Determine the standard time using rating of each engineer

(30)

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MECHANICAL ENGINEERING

Time Allowed: 3 hours **Maximum Marks : 300**

Candidates should attempt Questions Nos. 1 and 5 which are compulsory, and any three of the remaining questions selecting at least one question from each Section.

If any data is considered insufficient, assume suitable value.
Use of psychometric chart is permitted.

PAPER - II

SECTION A

1. Answer any three of the following parts (answer to each part should not exceed 200 words): (20 x 3 = 60)

(a) Consider a Carnot cycle heat engine operating in the outer space. Heat can be rejected from this engine only by thermal radiation, which is proportional to the radiator area and the fourth power of the absolute temperature of the radiator (T_1). Show that for a given engine work output and given temperature of the higher temperature reservoir (T_H), the radiator area will be a minimum when the ratio $T_1 / T_H = 3/4$.

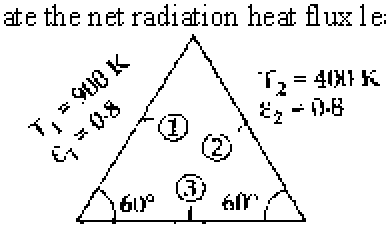
(b) A fluid, contained in a horizontal cylinder fitted with a frictionless leak-proof piston, is continuously agitated by means of stirrer passing through the cylinder cover The cylinder diameter is 0.40 m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485 m against the atmosphere. The net work done by the fluid during the process is 2 kj. The speed of the electric motor driving the stirrer is 840 rpm. Determine the torque in the shaft and the power output of the motor.

(c) A simple carburetor has a venturi throat diameter of 20 mm and the coefficient of flow is 0.8. The diameter of the fuel orifice is 1.14 mm and the coefficient of fuel is 0.65. The gasoline surface is 5 mm below the throat. Calculate—

(i) The air-fuel ratio for a pressure drop of 0.08 bar when the nozzle tip is neglected;
(ii) The air-fuel ratio when the nozzle tip is taken into account;
(iii) The minimum velocity of air or critical air velocity required to start the fuel flow when the nozzle tip is provided.
Assume the density of air and fuel to be 1.20 kg/m^3 and 750 kg/m^3 respectively.

(d) Consider a diffuse circular disc of diameter D and area A_j and a plane diffuse surface of area $A_i << A_j$. The surface are parallel and A_i is located at a distance L from the centre of A_j. Obtain an expression for view factor.

2. (a) The configuration of a furnace can be approximated as an equilateral triangular duct which is sufficiently long that the end effects are negligible. The hot wall is maintained at $T_1 = 900$ K and has an emissivity $\varepsilon_1 = 0.8$. The cold wall is at $T_2 = 400$ K and has an emissivity $\varepsilon_2 = 0.8$. The third wall is reradiating zone for which $Q_3 = 0$. The accompanying sketch illustrates the configuration. Calculate the net radiation heat flux leaving the hot wall.



(b) The diagram shows a truncated conical section fabricated from a material of thermal conductivity K The circular cross-section of the conical section has the diameter D = ax,

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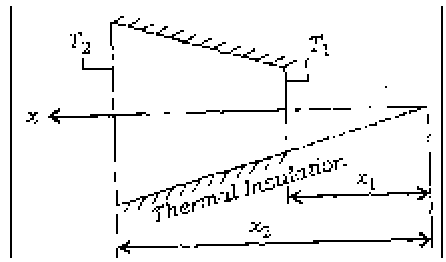
where a is a constant and x is the axial distance of the section from the apex of the cone. The temperatures at the two end faces of the conical section (at distances x_1 and x_1 from the apex) are respectively T_1 and T_2 while the lateral surface of the truncated cone is thermally insulated.



(i) Derive an expression for the temperature distribution T(X) in symbolic form assuming one-dimensional steady-state conditions. Sketch the temperature distribution.

(ii) Calculate the heat rate q_x through the cone in x-direction.

(20 + 40)

3. (a) A refrigeration system operates using simple saturated cycle with a certain refrigerant. The condensing and evaporating temperatures for the refrigerant are 35°C and -15°C respectively. Determine the COP of the system - If a liquid vapour heat exchanger is installed in the system, with the temperature of the vapour leaving the heat exchanger at 15°C, what will be the change in the COP?

Use the following data for the refrigerant used:

				Superheated			
				20 K		40 K	
t	h_f	h_g	s_g	h	s	h	s
°C	kJ/kg	kJ/kg	kJ/kg-K	kJ/kg	kJ/kg-K	kJ/kg	kJ/kg-K
35	69.5	201.5	0.6839	216.4	0.731	231.0	0.7741
-15	-	181.0	0.7052	193.2	0.751	205.7	0.7942

(b) 10 cu m of atmospheric air at 25°C DBT and 12°C WBT is flowing per minute through a duct. Dry saturated steam at 100 DC is injected through the duct. Dry saturated steam at 100°C is injected into the air stream with a rate of 1.2 kg/mm.

(i) What is the temperature of air after mixing the steam?

(ii) What is the relative humidity of air after mixing the steam?

(30 + 30)

4. (a) Sketch the axial-flow turbine cascade. Show the velocity with its components at entry exit indicating the forces exerted by the flow on blades. State the expression of ideal lift in terms of flow angles and show that it is equal to $pC_m \Gamma$, where C_m is the mean velocity and Γ is the circulation.

(b) The first axial-flow air compressor stage without inlet guide varies is operating at a speed of 15000 r.p.m. in the atmospheric conditions of T_0 = 288 K, P_0 = 1.01 bar. The rotor mean blade ring diameter is 0.34 m arid hub to tip ratio is 0.5. Atmospheric air enters the stage with a velocity of 150 m/s. Consider constant axial velocity through the stage and take stage efficiency as 0.86, mechanical efficiency as 0.97, work done factor as 0.97, C_p = 1.005 kJ/kg/K and R = 0.287 kJ/kg/K. Sketching the axial compressor stage with velocity diagrams and labelling with most general notations used in practice, determine the following for attaining relative velocity ration across rotor (de Haller number) of 0.73:

(i) Mass flow rate in kg/s

(ii) Maximum Mach number at rotor blade at entry

(iii) Angles made by relative and absolute velocity at rotor entry and exit with axial direction

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(iv) Power required to drive the compressor

(v) Stage pressure ratio

(10 + 50)

SECTION B

5. Answer any three questions

(20 x 3 = 60)

(a) Sketching 'load curve' and 'load duration curve explain their purposes. Define also 'demand factor' and 'plant-use factor

The loads for certain industries are tabulated below for 24 hours. During load duration and load curve, find power required for 40% of the time of the day. If the capacity of the power plant is 35 MW, find the capacity factor of the power plant:

Time :	6AM o 8AM	8AM to 9AM	9AM to 11AM	11AM to 2AM	2AM to 5AM
Load (in MW)	18	26	30	22	24
Time	5 PM to 8PM	8 PM to 12PM	12 PM to 5PM	5 PM to 6PM	
Load : (in MW)	30	20	15	16	

If the load is supplied by two power plants, one is acting as a base load plant having capacity of 25 MW and other as peak load plant having capacity of 10 MW, find load factor, capacity factor and use factor for both power plants.

(b) The stator blades of a gas turbine are supplied with gas whose stagnation enthalpy h_0 and stagnation temperature T_0 vary with radius r. There is cylindrical flow through the stator blades is reversible and adiabatic.

Show that, in the cross-sectional plane at exit from the stator blades

$$dh_0 - Tds = C^2 \sin^2\alpha \frac{dr}{r} + Cdc$$

Hence, when the gas can be assumed to be a perfect gas and the stagnation pressure P_0 is constant over the annulus, show that

$$\frac{dT_0}{T_0} = 2\left(\sin^2\alpha \frac{dr}{r} + \frac{dc}{C}\right)$$

(c) A quarter-scale turbine model is tested under a head of 10.8 m. The full-scale turbine is required to work under a head of 30 it and to run at 7.14 rev/s. At what speed the model must run? If it (model) develops 100 kW and uses 1.085 m^3 of water per second at this speed, what power will be obtained from the full-scale turbine, its efficiency being 3°Io better than that of model? What is the dimensionless specific speed of Full-scale turbine?

(d) Steel ball bearings (K = 50 W/m-K, α =1.3 x 10^{-5} m^2/s) having a diameter of 40 mm are heated to a temperature of 650 °C and then quenched in a tank of oil at 55 °C. If the heat transfer coefficient between the ball bearings and the oil is 300 W/m^2-K, determine:

(i) the duration of time the bearings must remain in oil to reach a temperature of 200 °C;

(ii) the total amount of heat removed from each bearing during this time;

(iii) the instantaneous heat transfer rate from the bearings when they are first immersed in oil and when they reach 200 °C.

6. (a) Define Rayleigh flow and mention its governing relations. Using them, establish the expression for the flow in the form $p + G^2v$ = Const., where G is the mass flow rate per unit

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area. Show the plot of this equation on h-s and p-v planes. Show also that at maximum enthalpy state

$$M = \frac{1}{\sqrt{\gamma}}.$$

(b) For the Rayleigh flow, establish the expression for T/T* terms of Mach number, M

(c) Air enters a 5 cm diameter frictionless duct with a Mach number 2. Its static temperature is 250 °C and stagnation pressure 6 bar. For increasing Mach number to 3, find the amount of heat to be transferred and change in static temperature. You may use the following table for air having $\gamma = 1.4$:

N	T/T*	P/P*	Po/Po	To/To*
2	0.5289	0.3636	1.503	0.7934
3	0.2803	0.1765	3.424	0.6534

7. (a) Why is the use of dust collector necessary in case of thermal power plant? Discuss the location of electrostatic precipitator with reference to sulphur content of coal and flue gas temperature.

(b) From the following data for the underfeed stoker boiler, find draft required in mm of water column and power required to drive the fan:

Mean temperatures of flue gases passing through duct	—	227 °C
Plenum pressure	—	15 cm of water
Atmospheric pressure	—	75 cm of Hg
Mean velocity of flue gases in duct	—	900 m/mm
Length of the duct	—	150 m
Mean size of the non-circular duct	—	75 cm^2
Number of 90° bends	—	4
Number of 45° bends	—	4
Loss of draft in every 90° bend	—	0.1 cm of water
Draft available from chimney	—	1.5 cm of water
Fuel bed resistance for underfeed stoker	—	10 cm of water
Fan efficiency	—	60%
Motor efficiency	—	92.5%

Assuming that 45° bend is equivalent to one-half of 90° bend, resistance offered by non-circular duct is 20% higher than a similar circular duct, friction factor for circular duct is 0.006, find draft required to be produced by fan and the fan power for flue gases. Take R = 294.35 3/kg-K.

(20 + 40)

8. To avoid having additional inlet and outlet pipes through the wall of the pressure vessel of pressurised water nuclear reactors, it is usual to employ a steam - heated reheat cycle. Steam is bled from the boiler delivery main to reheat the steam leaving the high-pressure turbine before it enters the low-pressure turbine. The data for the cycle are as follows:

Boiler outlet condition	—	Saturated steam at 60 bar
U' turbine inlet pressure	—	5 bar
Condenser pressure	—	0.05 bar
HP turbine isentropic efficiency	—	0.80 bar
LP turbine isentropic efficiency	—	0.87 bar
Reheat temperature	—	270 °C

The feed pump terms can be neglected, and it may be assumed that the bled steam leaves the reheater at a temperature equal to that at the high-pressure turbine exit, Determine the dryness fractions at the high- and low-pressure turbine exit and the cycle efficiency.

Also determine these quantities if no reheating were used. Comment briefly on the result.

(60)

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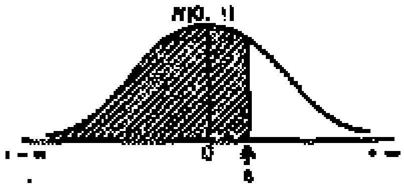
Cumulative distribution function for the standard normal distribution (SND)



For the SND, the table gives the cdf value at t, that is

$$\int_{-\infty}^{t} f(0,1)\,dz$$

t	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
−3·5	0·00023	0·00022	0·00022	0·00021	0·00020	0·00019	0·00019	0·00018	0·00017	0·00017
−3·4	0·00034	0·00033	0·00031	0·00030	0·00029	0·00028	0·00027	0·00026	0·00025	0·00024
−3·3	0·00048	0·00047	0·00045	0·00043	0·00042	0·00040	0·00039	0·00038	0·00036	0·00035
−3·2	0·00069	0·00066	0·00064	0·00062	0·00060	0·00058	0·00056	0·00054	0·00052	0·00050
−3·1	0·00097	0·00094	0·00090	0·00087	0·00084	0·00082	0·00079	0·00076	0·00074	0·00071
−3·0	0·00135	0·00131	0·00126	0·00122	0·00118	0·00114	0·00111	0·00107	0·00104	0·00100
−2·9	0·0019	0·0018	0·0017	0·0017	0·0016	0·0016	0·0015	0·0015	0·0014	0·0014
−2·8	0·0026	0·0025	0·0024	0·0023	0·0023	0·0022	0·0021	0·0021	0·0020	0·0019
−2·7	0·0035	0·0034	0·0033	0·0032	0·0031	0·0030	0·0029	0·0028	0·0027	0·0026
−2·6	0·0047	0·0045	0·0044	0·0043	0·0041	0·0040	0·0039	0·0038	0·0037	0·0036
−2·5	0·0062	0·0060	0·0059	0·0057	0·0055	0·0054	0·0052	0·0051	0·0049	0·0048
−2·4	0·0082	0·0080	0·0078	0·0075	0·0073	0·0071	0·0069	0·0068	0·0066	0·0064
−2·3	0·0107	0·0104	0·0102	0·0099	0·0096	0·0094	0·0091	0·0089	0·0087	0·0084
−2·2	0·0139	0·0136	0·0132	0·0129	0·0125	0·0122	0·0119	0·0116	0·0113	0·0110
−2·1	0·0179	0·0174	0·0170	0·0166	0·0162	0·0158	0·0154	0·0150	0·0146	0·0143
−2·0	0·0228	0·0222	0·0217	0·0212	0·0207	0·0202	0·0197	0·0192	0·0188	0·0183
−1·9	0·0287	0·0281	0·0274	0·0268	0·0262	0·0256	0·0250	0·0244	0·0239	0·0233
−1·8	0·0359	0·0351	0·0344	0·0336	0·0329	0·0322	0·0314	0·0307	0·0301	0·0294
−1·7	0·0446	0·0436	0·0427	0·0418	0·0409	0·0401	0·0392	0·0384	0·0375	0·0367
−1·6	0·0548	0·0537	0·0526	0·0516	0·0505	0·0495	0·0485	0·0475	0·0465	0·0455
−1·5	0·0668	0·0655	0·0643	0·0630	0·0618	0·0606	0·0594	0·0582	0·0571	0·0559
−1·4	0·0808	0·0793	0·0778	0·0764	0·0749	0·0735	0·0721	0·0708	0·0694	0·0681
−1·3	0·0968	0·0951	0·0934	0·0918	0·0901	0·0885	0·0869	0·0853	0·0838	0·0823
−1·2	0·1151	0·1131	0·1112	0·1093	0·1075	0·1056	0·1038	0·1020	0·1003	0·0985
−1·1	0·1357	0·1335	0·1314	0·1292	0·1271	0·1251	0·1230	0·1210	0·1190	0·1170
−1·0	0·1587	0·1562	0·1539	0·1515	0·1492	0·1469	0·1446	0·1423	0·1401	0·1379
−0·9	0·1841	0·1814	0·1788	0·1762	0·1736	0·1711	0·1685	0·1660	0·1635	0·1611
−0·8	0·2119	0·2090	0·2061	0·2033	0·2005	0·1977	0·1949	0·1922	0·1894	0·1867
−0·7	0·2420	0·2389	0·2358	0·2327	0·2296	0·2266	0·2236	0·2206	0·2177	0·2148
−0·6	0·2743	0·2709	0·2676	0·2643	0·2611	0·2578	0·2546	0·2514	0·2483	0·2451
−0·5	0·3085	0·3050	0·3015	0·2981	0·2946	0·2912	0·2877	0·2843	0·2810	0·2776
−0·4	0·3446	0·3409	0·3372	0·3336	0·3300	0·3264	0·3228	0·3192	0·3156	0·3121
−0·3	0·3821	0·3783	0·3745	0·3707	0·3669	0·3632	0·3594	0·3557	0·3520	0·3483
−0·2	0·4207	0·4168	0·4129	0·4090	0·4052	0·4013	0·3974	0·3936	0·3897	0·3859
−0·1	0·4602	0·4562	0·4522	0·4483	0·4443	0·4404	0·4364	0·4325	0·4286	0·4247
−0·0	0·5000	0·4960	0·4920	0·4880	0·4840	0·4801	0·4761	0·4721	0·4681	0·4641

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Cumulative distribution function for the standard normal distribution (SND)

z	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
+0·0	0·5000	0·5040	0·5080	0·5120	0·5160	0·5199	0·5239	0·5279	0·5319	0·5359
+0·1	0·5398	0·5438	0·5478	0·5517	0·5557	0·5596	0·5636	0·5675	0·5714	0·5753
+0·2	0·5793	0·5832	0·5871	0·5910	0·5948	0·5987	0·6026	0·6064	0·6103	0·6141
+0·3	0·6179	0·6217	0·6255	0·6293	0·6331	0·6368	0·6406	0·6443	0·6480	0·6517
+0·4	0·6554	0·6591	0·6628	0·6664	0·6700	0·6736	0·6772	0·6808	0·6844	0·6879
+0·5	0·6915	0·6950	0·6985	0·7019	0·7054	0·7088	0·7123	0·7157	0·7190	0·7224
+0·6	0·7257	0·7291	0·7324	0·7357	0·7389	0·7422	0·7454	0·7486	0·7517	0·7549
+0·7	0·7580	0·7611	0·7642	0·7673	0·7704	0·7734	0·7764	0·7794	0·7823	0·7852
+0·8	0·7881	0·7910	0·7939	0·7967	0·7995	0·8023	0·8051	0·8079	0·8106	0·8133
+0·9	0·8159	0·8186	0·8212	0·8238	0·8264	0·8289	0·8315	0·8340	0·8365	0·8389
+1·0	0·8413	0·8438	0·8461	0·8485	0·8508	0·8531	0·8554	0·8577	0·8599	0·8621
+1·1	0·8643	0·8665	0·8686	0·8708	0·8729	0·8749	0·8770	0·8790	0·8810	0·8830
+1·2	0·8849	0·8869	0·8888	0·8907	0·8925	0·8944	0·8962	0·8980	0·8997	0·9015
+1·3	0·9032	0·9049	0·9066	0·9082	0·9099	0·9115	0·9131	0·9147	0·9162	0·9177
+1·4	0·9192	0·9207	0·9222	0·9236	0·9251	0·9265	0·9279	0·9292	0·9306	0·9319
+1·5	0·9332	0·9345	0·9357	0·9370	0·9382	0·9394	0·9406	0·9418	0·9429	0·9441
+1·6	0·9452	0·9463	0·9474	0·9484	0·9495	0·9505	0·9515	0·9525	0·9535	0·9545
+1·7	0·9554	0·9564	0·9573	0·9582	0·9591	0·9599	0·9608	0·9616	0·9625	0·9633
+1·8	0·9641	0·9649	0·9656	0·9664	0·9671	0·9678	0·9686	0·9693	0·9699	0·9706
+1·9	0·9713	0·9719	0·9726	0·9732	0·9738	0·9744	0·9750	0·9756	0·9761	0·9767
+2·0	0·9772	0·9778	0·9783	0·9788	0·9793	0·9798	0·9803	0·9808	0·9812	0·9817
+2·1	0·9821	0·9826	0·9830	0·9834	0·9838	0·9842	0·9846	0·9850	0·9854	0·9857
+2·2	0·9861	0·9864	0·9868	0·9871	0·9875	0·9878	0·9881	0·9884	0·9887	0·9890
+2·3	0·9893	0·9896	0·9898	0·9901	0·9904	0·9906	0·9909	0·9911	0·9913	0·9916
+2·4	0·9918	0·9920	0·9922	0·9925	0·9927	0·9929	0·9931	0·9932	0·9934	0·9936
+2·5	0·9938	0·9940	0·9941	0·9943	0·9945	0·9946	0·9948	0·9949	0·9951	0·9952
+2·6	0·9953	0·9955	0·9956	0·9957	0·9959	0·9960	0·9961	0·9962	0·9963	0·9964
+2·7	0·9965	0·9966	0·9967	0·9968	0·9969	0·9970	0·9971	0·9972	0·9973	0·9974
+2·8	0·9974	0·9975	0·9976	0·9977	0·9977	0·9978	0·9979	0·9979	0·9980	0·9981
+2·9	0·9981	0·9982	0·9982	0·9983	0·9984	0·9984	0·9985	0·9985	0·9986	0·9986
+3·0	0·99865	0·99869	0·99874	0·99878	0·99882	0·99886	0·99889	0·99893	0·99896	0·99900
+3·1	0·99903	0·99906	0·99910	0·99913	0·99916	0·99918	0·99921	0·99924	0·99926	0·99929
+3·2	0·99931	0·99934	0·99936	0·99938	0·99940	0·99942	0·99944	0·99946	0·99948	0·99950
+3·3	0·99952	0·99953	0·99955	0·99957	0·99958	0·99960	0·99961	0·99962	0·99964	0·99965
+3·4	0·99966	0·99967	0·99969	0·99970	0·99971	0·99972	0·99973	0·99974	0·99975	0·99976
+3·5	0·99977	0·99978	0·99978	0·99979	0·99980	0·99981	0·99981	0·99982	0·99983	0·99983

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