ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ ਜਲੰਧਰ
PUNJAB TECHNICAL UNIVERSITY JALANDHAR

Max.   Marks: 90   **Time: 90 Mins.**

Entrance Test for Enrollment in Ph.D. Programme

Important Instructions
➤ Fill all the information in various columns, in capital letters, with blue/black ball point pen.
➤ Use of calculators is not allowed.
➤ All questions are compulsory. No negative marking for wrong answers.
➤ Each question has only one right answer.
➤ Questions attempted with two or more options/answers will not be evaluated.

Stream: (Engg./Arch./Pharm/Mgmt./App.Sci./Life.Sc.)   :……. ENGINEERING…………………………

Discipline/Branch: : …….. Mechanical Engineering………………

Name;   : …………………………………………………..

Father's Name.   : …………………………………………………

Roll No.   : …………………………..Date…………………

Signature of the Candidate,   : …………………………………………………

Signature of the Invigilator,   : …………………………………………………..

Q.1.   If $Z = \log\left(x^2 + y^2\right)$, then $x\dfrac{\partial z}{\partial x} + y\dfrac{\partial z}{\partial y}$ is equal to
(A) 0,
(B) 1,
(C) 2,
(D) 3

Q.2. The volume of an object expressed in spherical coordinates is given by
$$V = \int_0^{2\pi} \int_0^{\frac{\pi}{3}} \int_0^1 r^2 \sin\phi\, dr\, d\phi\, d\theta,\text{ value of}$$
this integral is

(A) $\dfrac{\pi}{3}$,

(B) $\dfrac{\pi}{6}$,

(C) $\dfrac{2\pi}{3}$,

(D) $\dfrac{\pi}{4}$

Q.3. The differential equation
$$y'' + \left(S^3 \, Sinx\right)^5 y' + y = Cos\, x^3 \text{ is}$$
(A) First order and linear,
(B) First order and non-linear
(C) Second order and linear,
(D) Non-homogeneous with constant co-efficient

Q.4. The number of boundary conditions required to solve the following differential equation
$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0 \quad \text{is/are}$$
(A) 2,   (B) 4,
(C) 3,   (D) 1

Q.5. For the differential equation $\dfrac{dy}{dt} + 5y = 0$ with y(0) = 1, the general solution is

(A) e^{5t};

B) e^{-5t};

C) $5e^{-5t}$;

(D) $e^{\sqrt{-5t}}$

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Q.6. $\lim_{x \to 0} \frac{Sin^2 x}{x}$ is equal to

(A) 0   (B) α
(C) 1   (D) -1

Q.7. For what value of Z is the function f(Z) = Cosec Z continuous?
(A) Except at $Z = n.\pi$; n is integer ;
(B) Except at $Z = n.(\pi/2)$; n is integer ;
(C) Except at $Z = n.(\pi/4)$; n is integer ;
(D) None of these.

Q.8. The function $f(Z) = \frac{x y^2 (x+iy)}{x^2 + y^4}$; $Z \neq 0$; and

f(0) = 0, is
(A) not analytic at the origin;
(B) analytic at the origin,
(C) can't be said;
(D) none of these.

Q.9. Expand log Sin (x + h) in powers of 'h' by Taylor's theorem, the result is
 (A) log sin x + h cot x – (1/2) h² cosee² x +(1/3) h³ cosec² x cot x + …………….
 (B) log cos x + h tan x – (1/2) h² see² x +(1/3) h³ sec² x tan x + …………….
 (C) log cosee x + h cot x –(1/2) h² see² x + (1/3) h³ sec² x cot x + …………….
 (D) log sin x + h tan x –(1/2) h² see² x + (1/3) h³ sec² x cot x + …………….

Q.10. The probability that a leap year has 53 Sunday is
(A) 1/7   (B) 2/7
(C) 5/7   (D) 6/7

Q.11. The probability that a number selected at random between 100 and 999 (both inclusive) will not contain the digit 7 is
(A) 16/25   (B) (9/10)³
(C) 27/75   (D) 18/25.

Q.12. The following data about the flow of liquid was observed in a continuous chemical process plant

Frequency	Flow rate (litres/see)
7.5 to 7.7	1
7.7 to 7.9	5
7.9 to 8.1	35
8.1 to 8.3	17
8.3 to 8.5	12
8.5 to 8.7	10

The mean flow rate is
(A) 8.00 litres/sec;
(B) 8.06 litres/see

(C) 8.16 litres/sec
(D) 8.26 litres /sec

Q.13. The accuracy of Simpson's rule quadrature for a step size 'h' is
(A) O (h²);
(B) O(h³);
(C) O(h⁴);
(D) O(h⁵)

Q.14. Evaluate $\int_0^6 \frac{dx}{1+x^2} dx$ using Trapizoidal rule, the answer is
(A) 1.51;
(B) 1.41;
(C) 1.61;
(D) 1.71

Q.15. Evaluate $\int_0^1 \frac{2x}{1+x^2} dx$ using Simpson's rule, the answer is
(A) 0.693;
(B) 0.593;
(C) 0.721;
(D) 0.491

Q.16. The angular momentum of a system is conserved if there
(A) are no forces present;
(B) are no magnetic forces present;
(C) is no net force on the system,
(D) are no torque present.

Q.17. A cube strikes a billiard ball, exerting an average force of 50 N over a time of 10 millisecond. If the ball has mass of 0.20 Kg, its speed after the impact will be
 (A) 0.5 m/s,
(B) 1.5 m/s;
(C) 2.5 m/s;
(D) 5.0 m/s.

Q.18. According to the Lami's theorem
 (A) Three forces acting at a point will be in equilibrium,
 (B) Three forces acting at a point can be represented by a triangle each side being proportional to force,
 (C) If three forces acting upon a particle are represented in magnitude and direction by the sides of a triangle taken in order they will be in equilibrium,
 (D) If three forces acting at a point are in equilibrium each force is proportional to the 'sin' of the angle between the other two.

Q.19. A ball moving with a velocity of 5 m/s impinges on a fixed plane at an angle of 45^0, its direction after impact is equally inclined to the line of impact. If co-efficient of restitution is 0.5, the velocity of the ball after impact will be
(A) 0.5 m/s,
(B) 1.5 m/s,
(C) 2.5 m/s;
(D) 3.5 m/s.

Q.20. The maximum principal strain in a thin cylinder tank, having radius of 25 cm and wall thickness of 5 mm when subjected to an internal pressure of 1 MPa is (taking Young's modulus as 200 GPa and Poisson's ratio as 0.2)
(A) 2.25×10^{-4},
(B) 2.25,
(C) 2.25×10^{-6};
(D) 22.5

Q.21. If a circular shaft is subjected to a torque 'T' and a bending moment 'M' the ratio of the maximum shear stress to the maximum bending stress is
(A) (2M)/T,
(B) T/(2M),
(C) (2T)/M;
(D) M/(2T).

Q.22. A Mohr's circle reduces to a point when the body is subjected to
(A) Pure shear,
(B) Uniaxial stress only,
(C) Equal and opposite axial stresses on two mutually perpendicular planes, the planes being free of shear;
(D) Equal axial stress on two mutually perpendicular planes, the planes being free of shear.

Q.23.The buckling load for a column pinned at both ends is 10 kN. If the ends are fixed, the buckling load changes to
(A) 40 kN,
(B) 2.5 kN,
(C) 5 kN;
(D) 20 kN.

Q.24. The gear train usually employed in clocks is a
(A)Reverted gear train,
(B) Simple gear train,
(C) Sun and planet gear;
(D) Differential gear.

Q.25. A flywheel of moment of inertia 9.8 kg-m^2 fluctuates by 30 rpm for a fluctuation in energy of 1936 Joules. The mean speed of the flywheel is (in rpm)
(A) 600,
(B) 900,
(C) 968;
(D) 2940.

Q.26.A mechanism is an assembly of
(A) two links,
(B) three links,
(C) four links or more than four links;
(D) all of the above.

Q.27. The value of velocity and acceleration of piston at near dead centre for a slider-crank mechanism will be
(A) 0, and more than $\omega^2.r$,
(B) 0, and less than $\omega^2.r$,
(C) 0, 0;
(D) ωr, 0.

Q.28. Critical damping is a function of
(A) mass and stiffness,
(B) mass and damping co-efficient,
(C) stiffness and natural frequency;
(D) natural frequency and damping co-efficient.

Q.29. Critical speed is the speed at which the shaft tends to vibrate violently in

(A) transverse direction,
(B) longitudinal direction,
(C) linear direction;
(D) none of the above.

Q.30. Guest's theory of failure is applicable for which of the following type of materials?
(A) Brittle,
(B) Ductile,
(C) Elastic;
(D) Plastic.

Q.31.The key will fail in which of the following manner?
(A) Shearing,
(B) Crushing,
(C) Both crushing and shearing;
(D) None of the above.

Q.32. The most efficient riveted joint possible in one which would be as strong in tension, shear and bearing as the original plates to be jointed. But this can never be achieved because
(A) Rivets can not be made with the same material,
(B) Rivets are weak in compression,
(C) There should be at least one hole in the plate reducing its strength;
(D) Clearance is present between the plate and the rivet.

Data for questions Q.33.–Q.34.
A multiple disc clutch has fire plates having four pairs of active friction surfaces. The intensity of pressure is not to exceed 0.127 N/mm^2. The outer and inner radius of friction surfaces are 125 mm and 75 mm respectively. Assume uniform wear and take co-efficient of friction = 0.3,

Q.33. The axial force required to engage the clutch is
(A) 2846 N,
(B) 2993 N,
(C) 3124 N;
(D) 3327 N.

Q.34. The power transmitted at 500 rpm is
(A) 16.4 kW,
(B) 18.8 kW,
(C) 19.4 kW;
(D) 20.4 kW.

Q.35. Centre of buoyancy is
(A) The point of intersection of buoyant force and centre line of the body,
(B) Centre of gravity of the body,
(C) Centroid of displaced volume fluid;
(D) Mid point between C.G. and metacentre.

Q.36. A large Reynold number is indication of
(A) smooth and streamline flow,
(B) laminar flow,
(C) steady flow;
(D) highly turbulent flow.

Q.37. In steady flow of a fluid, the acceleration of any fluid particle is
(A) constant,
(B)variable,
(C) zero;
(D) never zero.

Q.38.Head loss in turbulent flow in a pipe
(A) varies directly as velocity,
(B) varies inversely as square of velocity,
(C) varies approximately as square of velocity; (D) varies inversely as velocity.

Q.39.Bernoulli's equation cannot be applied when the flow is
(A) rotational,
(B) turbulent,
(C) unsteady;
(D) all of the above.

Q.40. The ratio of energy transferred by convection to that by conduction is called
(A) Stanton number,
(B) Nusselt number,
(C) Biot number;
(D) Preclet number.

Q.41. In radioactive heat transfer, a gray surface is one
(A) which appears gray to the eye,
(B) whose emissivity is independent of wavelength,
(C) which has reflectivity equal to zero;
(D) which appears equally bright from all directions.

Q.42.What happens when the thickness of insulation on a pipe exceeds the critical value?
(A) Heat transfer rate increases,
(B) Heat transfer rate decreases,
(C) Heat transfer rate remain constant;
(D) none of these.

Q.43. In heat exchangers, the value of logarithmic mean temperature difference should be
(A) maximum possible,
(B) minimum possible,
(C) zero;
(D) constant

Q.44. Air at 20 ^{0}C blows over a plate of 50 cm x 75 cm maintained at 250^0 C. If the convection heat transfer coefficient is 25 W/m^2 ^{0}C, the heat transfer rate is
(A) 215.6 kW,
(B) 2156 kW,
(C) 2.156 kW;
(D) 21.56 kW.

Q.45. A system comprising of a single phase, is known as
(A) open system,
(B) close system,

(C) homogeneous system;
(D) heterogeneous system.

Q.46.A reversible process
A) must pass through a continuous series of equilibrium states,
(B) leaves no history of the events in surroundings,
(C) must pass through the same states on the reversed path as on the forward path;
(D) all of the above.

Q.47. The Carnot cycle consists of two adiabatic processes and
(A) two isothermal processes,
(B) two constant pressure processes,
(C) two constant volume processes;
(D) one constant pressure process.

Q.48.In a reversible engine, the source temperature is 227^0C and the sink temperature is 27^0C. The maximum available work for a heat input of 100 kJ will be
(A) 100 kJ,
(B) 60 kJ,
(C) 40 kJ;
(D) 88 kJ.

Data for Q.49.-Q.50
2.5 cubic metre of a gas at 800 kPa and 180 ^{0}C are heated at constant pressure until the volume is doubled, $C_p = 1.006$ KJ/kg ^{0}K and $C_V = 0.7134$ Kj/kg ^{0}K

Q.49. Find the change in internal energy
(A) 4966.8 kJ,
(B) 5876.4 kJ,
(C)5643.5 kJ;
(D) 5346.6 kJ.

Q.50. Find the work done during the process
(A) 1000 kJ,
(B) 2000 kJ,
(C) 3000 kJ;
(D) 4000 kJ.

Q.51. In reaction turbine, when the degree of reaction is zero, then there is
(A) no heat drop in moving blades,
(B) no heat drop in the fixed blades,
(C) maximum heat drop in the moving blades ; (D) maximum heat drop in the fixed blades.

Q.52. In petrol engines the sparking increases
(A) pressure,
(B) volume,

(C) temperature of the product of combustion; (D) both (A) and (B)

Q.53. Air standard efficiency of an I.C. engine depends on
(A) speed,
(B) compression ratio,
(C) fuel;
(D) all of the above

Q.54. In S.I. unit, one tonne of refrigeration is equal to
(A) 110 kJ/min,
(B) 210 kJ/min,
(C) 50 kJ/min;
(D) non of the above

Q.55. Subcooling occurs when the vapour
(A) has high latent heat,
(B) removes sensible heat from refrigerant,
(C) has low latent heat;
(D) has high thermal conductivity.

Q.56. The refrigerant used in vapour absorption refrigerator is
(A) Freon-12,
(B) Ammonia,
(C) CO_2;
(D) Aqua-ammonia

Q.57. Ambient air dry bulb temperature is 45 ^{0}C and wet bulb temperature is 27 ^{0}C. Select the lowest possible condensing temperature from the following for an evaporatively cooled condenser.
(A) 25 ^{0}C,
(B) 30 ^{0}C,
(C) 42 ^{0}C;
(D) 48 ^{0}C.

Data for Q.58. – Q.59.
A Francis turbine running at 200 rpm develops a power of 5000 kW under a head of 25 m.

Q.58. Determine the power output under a head of 100m
(A) 20,000 kW,
(B) 30,000 kW,
(C) 40,000 kW;
(D) 50,000 kW.

Q.59. Determine the speed under a head of 100m
(A) 300 rpm,
(B) 320 rpm,
(C) 360 rpm;
(D) 400 rpm.

Q.60. A turbine develop 1600 H.P. while running at 375 rpm under 8m head. The turbine should be
(A) Kaplan turbine,
(B) Francis turbine,
(C) Pelton wheel;
(D) None of the above.

Q.61. The structure which have the highest packing of atoms are
(A) Hexagonal closed packed lattice,
(B) Body centre cubic lattice,
(C) Simple cubic lattice;
(D) None of these.

Q.62. A ductile fracture is usually not preceded by
(A) large amount of non-recoverable energy absorption,
(B) plastic flow,
(C) deformation;
(D) noise,

Q.63.The fatigue failure of a material can be avoided by
(A) coating the surface,
(B) shot peening,
(C) nitriding;
(D) any of the above.

Q.64. Which of the following metal has lowest melting point?
(A) Antimony,
(B) Tin,
(C) Silver;
(D) Zinc.

Q.65. Metal with hexagonal close packed structure is
(A) silver,
(B) Iron,
(C) Magnesium;
(D) Aluminium.

Q.66. Austempering is the heat treatment process used to obtain greater
(A) hardness,
(B) toughness,
(C) brittleness;
(D) ductility.

Data for Q.67.-Q.68.
For casting aluminium cube of sides 15 cm, the volume of shrinkage of aluminium during solidification is 6.5%. If cylindrical top riser is used then,

Q.67. What will be diameter of cylindrical riser?
(A) 18 cm,
(B) 21 cm,
(C) 25 cm;
(D) 24 cm.

Q.68. What will be the height of the cylinder?
(A) 6 cm,
(B) 9 cm,
(C) 12 cm;
(D) 16 cm.

Q.69. Two solid work-piece, a sphere with radius R and a cylinder with diameter equal to its height, have to be sand cast. Both work-pieces have the same volume. The cylindrical work-piece will solidify as compared to the spherical work-piece.
(A) slower,
(B) faster,
(C) same;
(D) uncertain.

Q.70. Two castings of the same metal have the same surface area. One casting is in form of a sphere and the other is a cube. What is the ratio of the solidification time for the sphere to that of the cube?
(A) 3/4,
(B) $6/\pi$,
(C) $5/4\pi$;
(D) $3\pi/8$.

Data for Q.71.-Q.72.
A block of lead 25 mm x 25 mm x 150 mm is pressed between flat dies to a size of 6.25 mm x 100 mm x 150 mm. If the flow stress $\sigma_0 = 7$ N/mm^2 and $\mu = 0.25$.

Q.71. The maximum pressure will be given by
(A) 59.6 N/mm^2,
(B) 69.6 N/mm^2,
(C) 79.6 N/mm^2;
(D) 89.6 N/mm^2.

Q.72. Total forging pressure will be given by
(A) 362 kN,
(B) 462 kN,
(C) 562 kN;
(D) 662 kN.

Q73. In hot working process
(A) poor surface finish is produced,
(B) scale is formed on metal surface,
(C) close tolerance can be maintained;

(D) all of the above.

Q.74. Cold working of metal increases

(A) tensile strength,
(B) hardness,
(C) yield strength;
(D) all of the above.

Q.75.Seamless tube can be produced by
 (A) two high rolling mill,
(B) ring rolling combined with stretch forming,
(C) piercing;
(D) steam hammering forging.

Q.76.Cold or hot rolling does not produce
(A) a hollow circular section,
(B) a T-section,
(C) an I-section;
(D) a channel section.

Data for Q.77.-Q.78.
The voltage length characteristic of a direct current (d.c.) 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 = 80 V and a short circuit current = 1000 amp.

Q.77. What is the optimum arc length?
(A) 0.3 cm,   (B) 0.4 cm,
(C) 0.5 cm;   (D) 0.6 cm.

Q.78. What is maximum arc power?
(A) 10 kVA,
(B) 20 kVA,
(C) 30 kVA;
(D) 50 KVA,

Q.79. In spot welding, the electrode tip diameter (D) should be equal to
(A) $\sqrt{t}$,
(B) 1.5 t,
(C) 3t;
 (D) 4.5t.
Where, t = thickness of the plate to be welded.

Q.80. In electro chemical machining (ECM) the material removal is due to
(A) corrosion,
(B) erosion,
(C) fusion;
(D) ion displacement,

Q.81. Tool life of 10 hours is obtained when cutting with single point tool at 63 m/min. If Taylor's constant C = 257.35, tool life on doubling the velocity will be
(A) 5 hours,,
(B) 25.7 min,
(C) 38.3 min;
(D) unchanged.

Q.82.Crater wear occurs mainly due to
(A) abrasion,
(B) diffusion,
(C) oxidation;
(D) adhesion.

Q.83. Tolerance are specified
(A) to obtain desired fits,
 (B) because it is not possible to manufacture in size exactly,
 (C) to obtain high accuracy;
(D) to have proper allowance.

Q.84. A comparator
(A) needs to be calibrated,
(B) need not be calibrated,
(C) contains a calibrated scale;
(D) is highly accurate over its complete measuring range.

Q.85. CAD/CAM is the interrelationship between
(A) marketing and design,
(B) manufacturing and marketing,
(C) engineering and marketing;
 (D) engineering and manufacturing.

Q.86 The difference between CAD and CAM is that CAD software is directed at product design while CAM software is
(A) concerned with production and control of tool design,
(B) designed for communications,
 (C) concerned with management programs;
(D) specially for PC –board design.

Q.87. Which one of the following forecasting techniques is not suited for making forecasts for planning production schedules in the short range?
(A) Moving average,
(B) Exponential moving average,
(C) Regression analysis;
(D) Delphi.

Q.88. The lead time consumption is 500 units. The annual consumption is 8000 units. The company has a policy of economic order quantity (EOQ) ordering and maintenance of 200 units as safety stock. The recorder point (ROP) as per safety stock inventory control system is

(A) 500 units,
(B) 700 units,
(C) 200 units;
(D) none of the above.

Q.89. In linear programming, shadow prices are
(A) cost of brought out items,
(B) maximum cost per item,
(C) value assigned to one unit of capacity;
(D) lowest sale prices.

Q.90. PERT and CPM are
(A) techniques to determine project status,
(B) decision making techniques,
(C) aids to determine the cost implications of project;
(D) aids for decision making.