Seat Number

* 2 0 0 0 *

Machine Design - I
(125103)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory and attempt **any two** bits out of a, b, c from each questions.
5. Design data book is allowed.
6. Use of non-programmable calculator is allowed.
7. Assume suitable data, if necessary.

UNIT - I

1. a) The load on a bolt consist of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to – **8**

i) maximum principal stress theory.

ii) maximum shear stress theory.

iii) maximum principal strain theory.

iv) Maximum strain energy theory.

Take permissible tensile stress at elastic limit = 100 MPa & Poisson's ratio = 0.3.

b) Design a Knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in a compression. **8**

c) Discuss the design procedure of spigot and socket cotter joint. **8**

UNIT – II

2. a) A mild steel shaft transmits 20 kw at 200 rpm. It carries a central load of 900 N and is simply supported between the bearings 2.5 meters apart. Determine the size of shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads ? **8**

b) Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90 kw at 250 rpm. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa. **8**

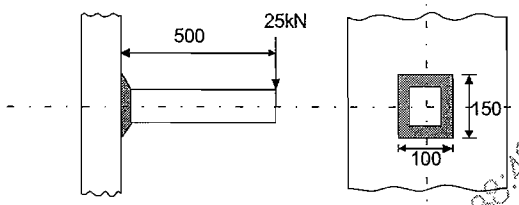
c) Explain :

i) Woodruff key. **4**

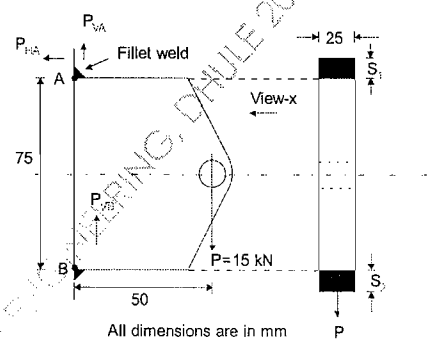
ii) ASME Code. **4**

UNIT – III

3. a) A rectangular cross-section bar is welded to a support by means of fillet welds as shown in fig. below. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 MPa. **8**



b) The bracket as shown in the fig below, is designed to carry a dead weight of P = 15 kN, what sizes of the fillet welds are required at the top and bottom of the bracket ? Assume the forces act through the points A & B. The welds are produced by shielded are welding process with a permissible strength of 150 MPa. **8**



c) Explain : 8
   i) Stresses in threaded joint.
   ii) Locking devices.

UNIT – IV

4. a) Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced. 8

   b) A single cylinder double acting steam engine develops 150 kw at a mean speed of 80 r.p.m. The co-efficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 meters and the hub & spokes provide 5% of the rotational inertia of the wheel, find the mass of the flywheel and cross-sectional area of the rim. Assume the density of the flywheel material as 7200 kg/m^3. 8

   c) Explain : 8
      i) Co-efficient of fluctuation of speed.
      ii) Co-efficient of steadiness.
      iii) Co-efficient of fluctuation of energy.
      iv) Stress in flywheel rim.

UNIT – V

5. a) Explain : 8
      i) Notch sensitivity.
      ii) Notch sensitivity factor.

   b) Explain : 8
      i) Stress concentration.
      ii) Stress concentration factor.

   c) Explain : 8
      i) Soderberg line.
      ii) Goodman line.

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चंदन - 042

Seat Number

* 2 0 0 2 *

Internal Combustion Engine
(125102 / 215102)

P. Pages : 2

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** bits out of a, b, and c in each question.
5. Draw neat sketches wherever necessary.
6. Assume suitable data, if requited.
7. Use of non- programmable calculator is allowed.

1. a) Derive an expression for efficiency and mean effective pressure for Otto cycle. **8**

b) a) Differentiate air standard cycle & actual cycle **4**

b) Define the following. **4**

i) Volumetric efficiency.

ii) Pumping losses.

c) An engine operating on diesel cycle, has the following data. **8**

Maximum temp. – 1277^0 C

Exhaust temp. – 447^0 C

Ambient conditions – 1 bar, 37^0C

Air consumption – 2 kg/min.

Estimate i) compression ratio

ii) Power output.

iii) Air standard efficiency

Assume c_p =1.005 KJ/Kg K and C_v = 0.718 KJ/ kg K.

2. a) i) What are the requirements of a good carburetor. **4**

ii) Explain valve overlap in detail. **4**

b) With neat sketch solex carburetor. **8**

c) i) Draw valve timing diagram for 4 stroke cycle diesel engine. **4**
ii) With neat sketch explain MPFI. **4**

3. a) i) With neat sketch explain water cooling in I. C. engine. **4**
ii) Differentiate Battery ignition and magneto ignition **4**

b) i) What are the requirements of good lubrication system? **4**
ii) What are the advantages of supercharging? **4**

c) What is lubrication? Explain splash lubrication system in detail. **8**

4. a) Explain combustion Phenomenon in SI engine. **8**

b) What are the factors affecting ignition lag in SI engine. **8**

c) i) Compare knock in SI & CI engine. **4**
ii) Explain cetane no. **4**

5. a) With neat sketch explain Morse test. **8**

b) Write short note on **8**
i) EGR system. ii) I. C. Engine pollutants.

c) During the trial of a single cylinder, four stroke oil engine, the following results were obtained. **8**
Cylinder diameter = 20 cm
Stroke = 40 cm
Mean effective pressure = 6 bar
Torque = 407 NM
Speed = 250 rpm
Oil consumption = 4 Kg/hr.
Calorific value of fuel = 43 MJ/Kg
Cooling water flow rate = 4.5 Kg/min
Air used per Kg of fuel = 30 kg.
Rise in cooling water temperature = 45^0C
Temperature of exhaust gas = 420^0C
Room temperature = 20^0C
Specific heat of exhaust gas = 1 KJ/ Kg K
Specific heat of water = 4.18 KJ/Kg K.
Find IP, BP & Draw up heat balance sheet in KJ/ hr.

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Seat Number

* 2 0 0 4 *

Industrial Safety & Engineering
(125105)

P. Pages : 2

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** bits from each question.
5. Use of non programmable calculator is allowed.

1. a) Explain principle of motion economy on the basis of use of the human body. **8**

b) Define work measurement and rate of working. What are the uses of work measurement? List the techniques of work measurement. **8**

c) Define the allowance in time study. Find standard & normal time if avag observed time is 8.6 min. with performance rating is 0.95 and allowance fraction is 0.125. **8**

2. a) Explain process layout. Give advantages of process layout. **8**

b) Define material handling. What are the objectives of material handling? List limitation of automated material handling system. **8**

c) Explain lifting technique in safe manual material handling. **8**

3.	a)	What do you mean by industrial psychology? Explain objective of industrial psychology.	**8**
	b)	Explain stages of group development. What are types of groups?	**8**
	c)	Explain Hawthorne effect. What are the major phases of Hawthorne experiment? Define types of industrial fatigue.	**8**
4.	a)	Define anthropometry. Explain environmental and human factor in detail.	**8**
	b)	Explain principles of safety management. Define industrial hygiene and occupational health.	**8**
	c)	Define i) Motivation communication ii) Safety performance monitoring iii) Accident investigation and reporting	**8**
5.	a)	Explain the strategies adopted in natural disasters in detail.	**8**
	b)	Explain i) Safety in hydro power plant. ii) Safety in nuclear power plant.	**8**
	c)	Explain any one man-made disaster. Define and give the causes and effects.	**8**

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Seat Number

* 2 0 0 6 *

Heat Transfer
(125101 / 215101)

P. Pages : 4

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** sub questions from each question.
5. Use of heat transfer data book is allowed in examination.

1. a) Derive Three dimensional steady state heat conduction equation without heat generation for Cartesian co-ordinate system. **8**

b) An industrial Freezer is designed to operate with an internal air temperature of -20°C, when an external air temperature is 25°C. The internal and external heat transfer coefficients are $12 W/m^2K$ & $8 W/m^2K$, respectively. The wall of the Freezer consists of inner layer of plastic ($K = 1 W/mK$), 3 mm thick and an outer layer of stainless steel ($K = 16 W/mK$), 1 mm thick. A layer of insulation material ($K = 0.07 W/mK$) is sandwitched between these two layers. Find the thickness of the insulation required to reduce the heat loss to $15 W/m^2$. **8**

c) A steam pipe of 5 cm ID and 6.5 cm OD is insulated with a 2.75 cm radial thickness of insulation ($K = 1.1 W/mK$). The surface heat transfer coefficient for inside & outside surface are $4650 W/m^2K$ & $11.5 W/m^2K$. The thermal conductivity of pipe material is $45 W/mK$. If the steam temperature is 200°c & ambient air temperature is 25°C, determine: **8**

i) heat loss per meter length of pipe.

ii) overall heat transfer coefficients based on inner & outer surfaces.

2. a) A large 3 cm thick steel plate ($K = 15.1\ W/mK$) is generating heat uniformly at the rate of $5 \times 10^6\ W/m^3$. Its both sides are expose to convection to an ambient at 30°C with heat transfer coefficient of $600\ W/m^2K$. Explain where in the plate highest and lowest temperature occur and calculate its values. **8**

b) Show that the rate of heat transfer from infinitely long fin is given by $Q = \sqrt{h P K A_C}\,(T_0 - T_\infty)$. **8**

c) The handle of a laddle used for pouring molten metal at 327°C is 30 cm long and is made of 2.5 cm X 1.5 cm M S bar stock ($K = 43\ W/mK$). In order to reduce the grip temperature, it is proposed to make a hollow handle of M S plate 0.15 cm thick to the same rectangular shape. If the surface heat transfer coefficient is $14.5\ W/m^2K$ and the ambient temperature is at 27°C, estimate the reduction in the grip temperature. Neglect the heat transfer from inner surface of hollow shape. **8**

3. a) Explain in detail thermal boundary layer. Sketch and explain the effect of Prandtl number on velocity boundary layer and thermal boundary layer. **8**

b) Air at a velocity of 3 m/s and at 20°C flows over a flat plate along its length. The length, width and thickness of the plate are 100 cm, 50 cm & 2 cm respectively. The top surface of the plate is maintained at 100°C. Calculate the heat lost by the plate and temperature of the bottom surface of the plate for the steady state conditions. The thermal conductivity of the plate may be taken as $23\ W/mk$. **8**

Use co-relation $N_{u_L} = 0.664 (Re_L)^{1/2}\ Pr^{1/3}$

Properties of air at mean film temperature is:

$K = 0.02894\ W/mK$, $v = 18.97 \times 10^{-6}\ m^2/s$, $Pr = 0.696$.

c) A block 10 cm X 10 cm X 10 cm in size is suspended in still air at 10°C with one of its surface in horizontal position. All surfaces of the block are maintained at 150°C. Determine total rate of heat transfer. **8**

Use for top surface : $Nu = 0.54 (Ra)^{1/4}$

for bottom surface : $Nu = 0.27 (Ra)^{1/4}$

for side surface : $Nu = 0.59 (Ra)^{1/4}$

4. a) Define: **8**

i) Monochromatic emissive power.

ii) emissivity.

iii) Radiosity.

iv) Shape factor.

b) A gray diffuse opaque surface (α=0.8) is at 100°C and receives an irradiation 1000 W/m^2. If the surface area is 0.1 m^2. Calculate **8**

i) Radiosity of the surface.

ii) Net radiative heat transfer rate from the surface.

iii) Calculate above quantities, if surface is black.

c) Define radiation shield, Prove that **8**

Q with n shields = $\left(\frac{1}{n+1}\right)$ Q without shield.

5. a) A concentric heat exchanger is used for heating 1110 Kg/ hr. of oil **8**
$(C_p = 2.1 KJ/Kg\ K)$ from a temperature of 27°C to 49°C. The oil flows through the inner pipe made of copper (OD = 2.86 cm, ID = 2.54 cm) & surface heat transfer coefficient on the oil side is 635 W/m^2K. The oil is heated by hot water supplied at the rate of 390 Kg/hr and at an inlet temperature of 93°C. The water side heat transfer coefficient is 1270 W/m^2 K. Take conductivity of copper to be $350 \frac{W}{mK}$ and fouling factors on oil & water sides to be 0.0001 and 0.0004 m^2. K/W. What is the length of heat exchanger for

i) Parallel flow.

ii) Counter flow.

Take $C_{p\ water} = 4180 \frac{J}{Kg\ K}$.

b) Derive $\varepsilon = \frac{1-\exp\{-NTU(1+C)\}}{1+C}$ for parallel flow heat exchanger. **8**

c) In an open heart surgery, under hypothermic conditions, the patient blood is cooled before surgery, and rewarmed afterwards. It is proposed that a concentric tube, counter flow heat exchanger of length 0.5 m be used for this purpose with a thin walled inner tube having a diameter of 55 mm. If the water at 60°C and 0.10 Kg/s is used to heat the blood entering the exchanger at 18°C and 0.05 Kg/s, what is the temperature of the blood leaving the exchanger? The overall heat transfer coefficient is 500 W/m^{2}K and specific heat of the blood is 3500 J/Kg K. Assume C_p of water as 4200 J/Kg K. **8**

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Seat Number

* 2 0 0 8 *

Theory of Machine - II
(125104 / 215104)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory and attempts **any two** bits out of a, b & c from each question.
5. Solve graphical problems on drawing sheet only.
6. Use of non programmable calculator is allowed.
7. Assume suitable data if necessary.

1. a) Explain the terms : **8**

1) Fluctuation of energy.

2) Fluctuation of speed.

3) Coefficient of fluctuation of energy.

4) Coefficient of fluctuation of speed.

b) Design a cam for operating the exhaust valve of an oil engine it is required to give equal uniform acceleration and retardation during opening and closing of the valve each of which corresponds to 60° of cam rotation. The valve must remain in the fully open position for 20° of cam rotation. **8**

The lift of the valve is 37.5 mm and least radius of cam is 40 mm. The follower is provided with a roller of radius 10 mm and its line of stroke passes through the axis of the cam.

c) Draw the profile of the cam when the roller follower moves with cycloidal motion during outstroke & return stroke, as given below. **8**
   1) Outstroke with maximum displacement of 31.4 mm during 180° of cam rotation.
   2) Return stroke for the next 150° of cam rotation.
   3) Dwell for remaining 30° of cam rotation.

   The maximum radius of cam is 20mm and the roller diameter of the follower is 10mm. The axis of roller follower is offset by 15mm towards right from the axis of cam shaft.

2. a) Explain with neat sketch prony brake absorption dynamometer. **8**

b) A simple band brakes operates on a drum of 600mm in diameter that is running at 200 r.p.m. The coefficient of friction is 0.25. The brake band has a contact of 270°, one end is fastened to a fixed pin and the other end to the brake arm 125mm from the fixed pin. The straight brake arm is 750mm long. Placed perpendicular to the diameter that biselt the angle of contact. **8**
   1) What is the pull necessary on the end of the brake arm to stop the wheel if 35 kw is being absorbed ? What is the direction for this minimum pull ?
   2) What width of steel band of 2.5mm thick is required for this brake if the maximum tensile stress is not exceed 50 N/mm^2.

c) A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and combined radius of gyration of 500mm. The two ends of the band are attached to pins on opposite sides of the brake lever at a distances of 30mm & 120mm from the fulcrum. If a force of 200 N is applied at a distance of 750mm from the fulcrum find; **8**
   1) Maximum braking torque.
   2) Angular retardation of the drum and
   3) Time taken by the system to come to rest from the rate of speed of 360 rpm.

   The coefficient of friction between blocks & drum may be taken as 0.25. Assume drum rotates in anticlockwise.

3. a) Explain effect of Gyroscopic couple on a Naval ship during. **8**

   1) Steering. 2) Pitching. 3) Rolling.

b) A loaded porter governor has four links each 250mm long, two revolving masses each of 3kg and central dead load of mass 20kg. All the links are attached to respective sleeves at radial distance of 40mm from the axis of rotation. The masses at a radius of 150mm at minimum speed and at a radius of 200mm at maximum speed. Determine the range of speed of governor. **8**

c) Explain & define the following terms relating to governors. **8**

1) Stability 2) Sensitiveness

3) Isochronism. 4) Hunting.

4. a) Explain : **8**
a) Swaying couple; and
b) Hammer blow for an uncoupled two cylinder locomotive engine.

b) Explain the method of balancing of different masses revolving in the same plane. **8**

c) A, B, C and D are four masses carries by a rotating shaft at radii 100, 125, 200 and 150mm respectively. The plane in which the masses revolve are spaced 600mm apart and the mass of B, C and D are 10 kg, 5 kg & 4 kg respectively. **8**

Find the required mass A and the relative angular setting of the four masses so that shaft shall be in complete balance.

5. a) Derive an expression for the length of the arc of contact in a pair of meshed spur gears. **8**

b) What do you understand by the term 'Interferance' & 'undercutting' as applied to gears. **8**

c) Two gear wheels mesh externally and arc to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6mm addendum = 1 module, pressure angle = 20°. The pinion rotates at 90 rpm. Determine **8**
1) The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel.
2) Length of path and arc of contact.

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Seat Number

* 2 0 9 2 *

Engineering Metallurgy
(1080)

P. Pages : 2

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory and attempt **any two** sub questions out of a, b, c.
5. Neat diagrams must be drawn wherever necessary.
6. Black figures to right indicate full marks.
7. Assume suitable data if necessary.
8. Use of non-programs calculator is allowed.

UNIT - I

1. a) Draw Fe-Fe_3C diagram and Explain the cooling of 0.6% and 1.2% slowly cooled carbon steel. Also draw the microstructure of the same. **10**

b) Write short notes on **any two.** **10**

1) Phosphorus pointing and sulphur pointing.
2) Flow lines observation.
3) Critical temperatures.

c) Explain the procedure for microscopic sample preparation for microscopic preparation. **10**

UNIT – II

2. a) Explain the procedure for plotting of TTT diagram. Draw typical TTT diagrams for Eutectoid, hypoeutectoid and hyper Eutectoid steels. **10**

b) Write short notes on **any two.** **10**

i) Martensitic Transformation.

ii) Peritectic transformation.

iii) Retained Austenite.

c) Explain the word Tempering and Explain in details Low, medium and high temperature tempering. **10**

UNIT - III

3. a) What is carburizing, explain method of carburizing in details. **10**

b) Classify and list all types of heat treatment furnaces and explain construction, working, advantage and disadvantages of continuous furnace and pit furnace. **10**

c) Write short notes on **any two.** **10**

i) Induction Hardening. ii) Nitriding.

iii) Flame Hardening.

UNIT – IV

4. a) Explain the effect of any five alloying on Alloy steels. Also classify Alloy steels. **10**

b) Classify cast Irons and explain in detail write cast Iron and Malleable CI. **10**

c) Explain high speed steels and heat treatment cycle of 18:4:1 type of HSS. **10**

UNIT – V

5. a) Give composition and uses of following. **10**

i) Invar ii) Brazing banon

iii) Phosphor bronze iv) LMB

v) Muntz metal.

b) Explain and classify composites, and explain in detail metal matrix composites & Reinforced composites. **10**

c) Write short notes on **any two.** **10**

i) Tin Bronzes. ii) Precipitation Hardening.

iii) Babbits.

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चंदन - 052

Seat Number

* 2 0 9 4 *

Machine Design - II
(1090)

P. Pages : 3

Time : Four Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Answer **any two** bits from each question.
5. Use of non-programmable calculator is allowed.
6. Assume suitable data if necessary.
7. Use of PSG design data book is allowed.

UNIT - I

1. a) Prove that $M_t = \frac{\mu P}{4}(D+d)$. **10**

Explain why uniform pressure theory is applicable, when friction lining is new.

b) A single plate clutch is designed to transmit 10 KW power at 2000 rpm. The equivalent mass and radius of gyration of the input shaft are 20 kg and 75 mm respectively. The equivalent mass and radius of gyration of the output shaft are 35 kg and 125 mm respectively. Calculate **10**

i) The time required to bring the output shaft to the rated speed from rest; and

ii) The heat generated during the clutching operation.

c) Write down the relationship between the energy absorbed by brake, braking torque and the angle through which the brake drum rotates during braking. **10**

UNIT – II

2. a) Explain the principle of ribbed belt, construction of ribbed belt and give the application of it. Give the application of round belt also. **10**

   b) It is required to select a V-belt drive to connect a 20 KW 1440 rpm motor to a compressor running at 480 rpm for 15 hrs per day. Space is available for a centre distance of approximately 1.2 m. Determine **10**
   i) the specification of the belt.
   ii) diameters of the motor and compressor pulleys.
   iii) the correct distance of centre; and
   iv) the number of belts.

   c) If is required to design a chain drive to connect a 12 KW at 1400 rpm electric motor to a centrifugal pump running at 700 rpm. The service conditions involve moderate shocks. **10**
   i) Select a proper roller chain and give a list of its dimensions.
   ii) Determine the pitch circle diameter of driving & driven sprockets.
   iii) Determine the number of chain links.
   iv) Specify the correct centre distance between the axes of sprockets.

UNIT – III

3. a) Explain the beam and wear strength of spur gear in detail. **10**

   b) The following data is given for a pair of spur gears with 20° full depth involute teeth. The number of teeth on pinion is 24, number of teeth on gear is 56, speed of pinion is 1200 rpm, module 3 mm, service factor 1.5 & face width is 30 mm. Both gears are made of steel with an ultimate tensile strength of 600 N/mm^2. Using the velocity factor to account for the dynamics loads, calculate : **10**
   i) Beam strength
   ii) Velocity factor and
   iii) rated power that the gears can transmit without bending failure, if the factor of safety is 1.5.

   c) A pair of parallel helical gear consist of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20°, while the helix angle is 25°. The face width is 40 mm and the normal module is 4 mm. The pinion as well as the gear is made of steel 40C8 (S_{ut} = 600 N/mm^2) and heat treated to surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 & 2 respectively. Assume that the velocity factors accounts for the dynamic load and calculate the power transmitting capacity of gears. **10**

UNIT – IV

4. a) A pair of bevel gears with 20° pressure angle, consist of a 20 teeth pinion meshing with a 30 teeth gear. The module is 4 mm, while the face width is 20 mm. The material of the pinion & gear is steel 50C4 (S_{ut} = 750 N/mm^2). The gear teeth are lapped and ground (Class-3) and the surface hardness is 400 BHN. The pinion rotates at 500 rpm & receives 2.5 KW power from the electric motor. The starting torque of the motor is 150% of the rated torque. Determine the factor of safety against bending failure & against pitting failure. **10**

b) Explain force analysis of worm gear. **10**

c) A pair of worm gear is designated as 1/30/10/8 calculate. **10**
i) The centre distance.
ii) The speed reduction.
iii) The dimension of the worm; and
iv) The dimension of the worm wheel.

UNIT – V

5. a) A ball bearing is subjected to a radial force of 2500 N and an axial force of 1000 N. The dynamic load carrying capacity of the bearing is 7350 N. The values of X & Y factors are 0.56 and 1.6 respectively. The shaft is rotating at 720 rpm. Calculate the life of bearing. **10**

b) Prove that $\sigma_t = t\, P_i \dfrac{\left(D_o^2 + D_i^2\right)}{\left(D_o^2 - D_i^2\right)}$. **10**

c) A high pressure cylinder consist of a steel tube with inner & outer diameter of 20 & 40 mm respectively. It is jacketed by an outer steel tube having outer diameter of 60 mm. The tubes are assembled by a shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm^2. Calculate the shrinkage Pr and original dimension of tubes (E=207 kN/mm^2). Also plot the distribution of stresses due to shrink fit. In service, the cylinder is further subjected to an internal pressure of 300 MPa. Plot the resultant stress distribution. **10**

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Seat Number

* 2 0 9 6 *

Project & Business Management
(1120)

P. Pages : 4

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Answer **any two** sub questions from each unit.
5. Black figures to the right indicate full marks.
6. Non-programmable electronic calculator is allowed.
7. Use of normal distribution table is permitted.
8. Assume suitable data, if necessary.

UNIT – I

1. a) i) Describe project life cycle curves. **7**

ii) What is meant by project monitoring ? **3**

b) The activity breakdown for a certain project is as follows: **10**

Activity	Duration (week)	Activity	Duration (week)
1	5	6	3
2	1	7	4
3	2	8	3
4	2	9	1
5	8	10	1

Activities 1, 4, 5 and 8 can be done concurrently. Activity 2 must follow activity one, activity 3 must follow activity 2, activity 6 must follow activity 5, activity 7 must follow activity 6, activity 9 must follow activity 8 and activity 10 must follow activity 7. Draw bar chart and find out total project duration.

c) Explain the following terms: **10**

i) Gantt progress chart.

ii) Tools and techniques for project management.

UNIT – II

2. a) i) Explain the rules devised by Fulkerson. **2**

ii) Consider the following table : **8**

Activity	Predecessor activity	Times in week		
		t_o	t_m	t_p
A	-	2	3	10
B	-	2	3	4
C	A	1	2	3
D	A	4	6	14
E	B	4	5	12
F	C	3	4	5
G	D, E	1	1	7

a) Draw network diagram.

b) Find critical path and variance of each event.

c) What is the probability that the project will be completed in 16 weeks.

b) i) Differentiate between CPM and PERT. **2**

ii) The utility data for a network are given below. Determine the total float, free float and independent float and identify the critical path. **8**

Activity	Duration weeks
1 – 2	2
2 – 3	8
2 – 4	10
3 – 5	6
4 – 5	3
3 – 6	3
4 – 7	7
5 – 8	5
6 – 8	2
7 – 8	8

c) i) Define float. Explain its different types and their importance. **4**

ii) Consider the PERT network given in Fig. 1. Determine the critical path, the expected activity duration and variances. Also calculate the probability of completing the project in
a) 12 days b) 14 days c) 10 days **6**

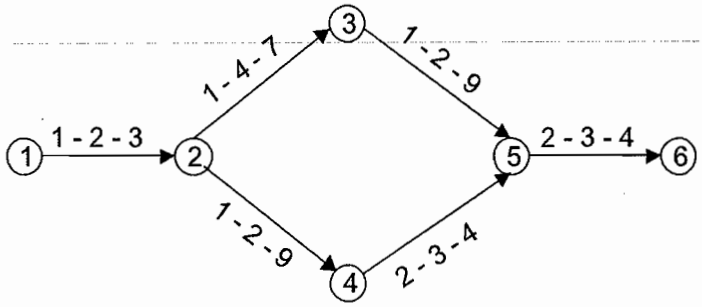

Fig. - I

UNIT – III

3. a) i) State the objectives, advantages and limitations of co-operative organisations. **5**

ii) Define partnership, Describe different types of partnership. **5**

b) What is meant by 'Joint stock company' ? Describe briefly the procedure for forming joint stock company. **10**

c) i) Discuss public sector undertaking in detail. **5**

ii) Explain private limited company. **5**

UNIT – IV

4. a) i) Mention and explain with examples various elements of cost. **4**

ii) Following figures relate to a company manufacturing a varied range of products. **6**

Period	Total sales (Rs.)	Total costs (Rs.)
1	42,500	38,700
2	39,200	36,852

Calculate :
i) Break even sales.
ii) Sales required to earn profit of Rs. 6,000 per period.

b) i) Explain the following terms. **4**
1) Fixed capital. 2) Working capital.
3) Fixed costs. 4) Variable costs.

ii) Define financial management. Describe functions of financial management. **6**

c) i) Differentiate between preference shares and equity shares. **2**

ii) The standard production for a particular work order is 30 units per day and piece rate wages is Rs. 2 per unit if daily production is 30 units or more. The rate is Rs. 1.50 per unit if production is less than 20 units cost of material is Rs. 1 per unit. It is proposed to charge factory overhead under one of the following methods. **8**

i) 100% on labour cost ii) 80% on prime cost

Tabulate the above data in the form of a suitable statement and indicate in the factory cost per unit, under each of the above methods if the daily production is

a) 20 units b) 30 units c) 40 units

UNIT – V

5. a) i) What is inventory control ? Explain the use of ABC analysis in inventory control. **4**

ii) XYZ co. buys its annual requirement of 36,000 units in six instalments. Each unit costs Rs. 1 and the ordering cost is Rs. 25. The inventory carrying cost is estimated at 20% of the unit value. Find the total cost of the existing inventory policy. How much money can be saved by using economic order quantity ? **6**

b) i) Differentiate between centralized and decentralized buying. **2**

ii) Explain in detail the principles of purchasing. **8**

c) From the following information in respect of material. Calculate the optimum order quantity. **10**

Order quantity	Price per kg
Less than 250	6.00
250 & less than 800	5.90
800 & less than 2000	5.80
2000 & less than 4000	5.70
4000 and above	5.60

The annual demand for material is 4000 kgs. carrying costs are 20% of the material cost per annum. The ordering cost is Rs. 10 per order.

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Seat Number

* 2 0 9 7 *

Turbo Machinery
(1100)

P. Pages : 3

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** sub questions from each unit.
5. Use of steam table, Mollier chart and non programmable calculator is allowed.
6. Assume suitable data if necessary and draw sketches wherever necessary.

UNIT – I

1. a) In case of steam turbines, derive expressions for the following : **10**

i) Force

ii) Work done

iii) Diagram efficiency.

iv) Stage efficiency.

v) Axial Thrust.

b) i) Give the difference between impulse and reaction turbine. **6**

ii) What is the purpose of compounding of impulse turbine? Mention the various types of compounding. **4**

c) In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 80cm and the speed of rotation is 3000 rpm. The steam issues from the nozzles with a velocity of 300 m/s and the nozzle angle is 20°. The rotor blades are equiangular and due to friction in the blade channels, the relative velocity of the steam at outlet from the blades is 0.86 times the relative velocity of steam entering the blades. What is the power developed in the blades when the axial thrust on the blades is 140 N? **10**

UNIT – II

2. a) Discuss the effect of pressure ratios on gas turbine cycle output, efficiency. Derive the optimum pressure ratio condition for an ideal gas turbine plant. **10**

b) i) Give the means of improving the efficiency and the specific output of simple cycle. **6**

ii) Define the work ratio and specific fuel consumption. **4**

c) The following data refer to an open gas turbine using intercooling, regeneration and reheating arrangement. **10**
Pressure ratio = 49, compressor inlet temp = 27°C.
Turbine inlet temp = 1300°C, compressor efficiency = 0.86
Turbine efficiency = 0.87, Regenerator effectiveness = 0.8
Combustion efficiency = 0.99, Mechanical efficiency = 0.97
Generator efficiency = 0.98,
Inlet pressure ratio to compressor = 1 bar.
Neglect pressure losses in intercooler, combustion chamber and regenerator.
Determine :
a) Cycle specific work b) Cycle thermal efficiency
c) Cycle work ratio d) Cycle air rate
e) For 220 mw power output, find mass flow rate of air.

UNIT – III

3. a) Explain the phenomenon of surging and choking in centrifugal air compressor. What is the effect of these phenomenon on the performance of the compressor. **10**

b) Define the following in turbo jet engine. **10**
i) Thrust ii) Thrust power iii) Propulsive efficiency
iv) Thermal efficiency v) Overall efficiency.

c) i) A centrifugal compressor has to deliver 30 kg of air per sec. The impeller is 76cm diameter revolving at 11500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4.2 : 1. Estimate the probable axial width of the impeller at the impeller tip if the radial velocity is 120 m/sec. The inlet conditions are 1 bar and 47°C. **6**

ii) Explain the various factors affecting the performance of a propulsion device. **4**

UNIT – IV

4. a) Differentiate between **10**

i) The impulse and reaction turbine.

ii) radial and axial flow turbine.

iii) inward and outward radial flow turbine.

iv) Kaplan and propeller turbine.

b) Derive an expression for hydraulic efficiency of a pelton wheel and what is the condition for maximum efficiency. **10**

c) The Pykara (South India) power house is equipped with impulse turbines of pelton type. Each turbine delivers a maximum horse power of 19300 when working under a head of 855m and running at 600 rpm. Find the least diameter of the jet and the mean diameter of the wheel. What it would be the appropriate diameter of orifice of the nozzle tip? Determine the value of the jet ratio and state if it is within limits. Specify the no. of buckets for the wheel. Take the overall efficiency of the turbine as 89.2%. **10**

UNIT – V

5. a) What is cavitation? Why it occurs? What are its effects? Describe some methods to avoid cavitation in water turbine. **10**

b) Derive the expression for the specific speed of a turbine. Explain its practical utility. Explain and derive the expression for the following i) unit power ii) unit discharge. **10**

c) Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000 kw under an effective head of 5 meter; overall efficiency of the turbine is 90%. The diameter of the boss is 0.4 times the external diameter of the runner. The turbine speed ratio is 2.0 and flow ratio is 0.6 what is the specific speed of the turbine. **10**

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चंदन - 056

Seat Number

* 2 0 9 9 *

Machine Design - I
(1020)

P. Pages : 3

Time : Four Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with black ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory.
5. Solve **any two** bits of A, B, C in each.
6. Non-programmable calculator is allowed.
7. Use of PSG design data book.
8. Assume suitable Data if necessary.

UNIT I

1. a) Explain General Procedure of Machine Design. Also state any five properties of materials. **10**

b) Write in Detail Design procedure for Kunckle Joint with neat sketches. Explain Maximum shear stress theory of failure. **10**

c) Design a sleeve? Cotter joint to resist a tensile load of 60 kN. All parts of the Joint are made of same material Take **10**

f_t = 60 N / mm^2, f_s = 70 N / mm^2, f_c = 125 N / mm^2.

UNIT II

2. a) Explain **10**

1) Shaft Design on strength basis.

2) Flat and Kennedy key.

b) Explain. **10**

i) Woodruff key and splines.

ii) ASME code for shaft Design.

c) Design a C.I. protective type flange coupling to transmit 15 KW at 900 rpm from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used. **10**

For bolt, shaft and key - f_s=40mPa.
For bolt and key - f_c=80mPa.
For C.I. - f_s=8mPa.

UNIT III

3. a) A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover is 1.25 N/mm^2. Calculate the number and size of studs required to fix the cylinder cover assume permissible stress in the shaft as 33 N/mm^2. **10**

b) i) Explain Bolt of uniform strength. **10**

ii) Axially loaded unsymmetrical welded Joint.

c) i) Stresses in Butt and fillet weld. **10**

ii) Difference between fillet weld and Butt weld Joint.

UNIT IV

4. a) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 420 mPa and modulus of rigidity is 84 kN/mm^2. Take **10**

$K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ where C-spring index.

b) Explain in Details design of screw Jack with neat sketch. **10**

c) Write short notes on. **10**

i) Self-locking and overhauling of power screw.

ii) Explain leaf spring.